The Welding Engineer

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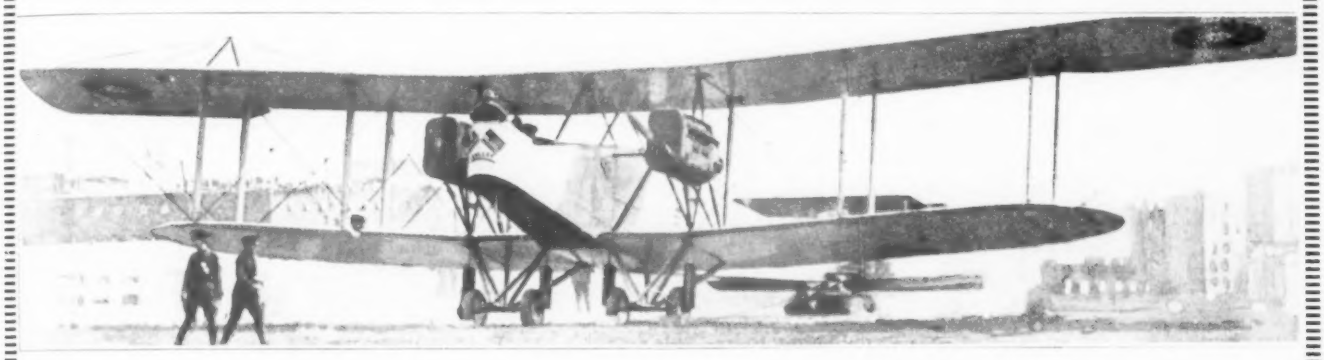

ON MARCH 1, 1918
ONE TORCHWELD TORCH WAS DEMONSTRATED IN A DETROIT FACTORY

ON SEPTEMBER 1, 1918
MANY HUNDRED TORCHWELD TORCHES WERE IN USE IN DETROIT ALONE

FOUR PROMINENT DETROIT MANUFACTURERS OF LIBERTY MOTORS

RECOGNIZED THE SUPERIORITY OF TORCHWELD TORCHES AND HAVE NOW IN DAILY USE ON THE MOST IMPORTANT WORK EVER PRODUCED, OVER

600

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THEY GET RESULTS. WE GET REPEAT ORDERS

AEROPLANE MANUFACTURERS, AMMUNITION MANUFACTURERS, AUTOMOBILE AND MOTOR MANUFACTURERS, STEEL AND GRAY IRON FOUNDRIES, MANUFACTURERS OF STAMPED AND PRESSED STEEL PARTS, SHIP YARDS, MACHINE SHOPS, BOILER SHOPS AND MANY OTHER KINDS OF MILLS AND FACTORIES IN NEARLY ALL PARTS OF THE COUNTRY HAVE BOUGHT TORCHWELD APPARATUS IN LARGE NUMBERS, VARYING FROM 234 IN ONE PLANT TO SINGLE EQUIPMENTS

CAN YOU AFFORD TO DO WITHOUT TORCHWELD APPARATUS? ARE YOU NOT ACCEPTING YOUR TORCH TROUBLES AS A NECESSARY EVIL? WRITE US FOR OUR NEW APPARATUS CIRCULAR. WE CAN HELP YOU

TORCHWELD EQUIPMENT COMPANY

230 NORTH CARPENTER STREET

CHICAGO

Manufacturers of High Grade Welding and Cutting Equipments, Welding Materials, Fluxes, Supplies and Accessories

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

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5 Everything needed for oxy-acetylene work we supply.

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Incorporated
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Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Commercial Acetylene Welding Co.
Universal Oxygen Co.

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The Welding Engineer
P. F. Willis.

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Torchweld Equipment Co.
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THAT not only must you have competent operators and efficient apparatus, but that you must also use welding supplies of the highest quality?

THAT the safest way is to purchase these supplies from concerns known to be thoroughly familiar with the requirements?

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K-G Welding & Cutting Co.
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Torchweld Equipment Co.

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Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Air Reduction Sales Co.
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Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
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Hauck Mfg. Co.
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The Prest-O-Lite Co.
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Westinghouse Electric & Mfg. Co.

TORCHES (Oxy-Acetylene Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Messer Mfg. Co.
Welding Supply Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Acetylene Welding)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
The Harris Calorific Co.
Messer Mfg. Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Messer & Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

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Bermo Supply Co.
Burdett Oxygen Co.
Messer Mfg. Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
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Torchweld Equipment Co.
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Burdett Oxygen Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Steel Sales Corp.
Torchweld Equipment Co.

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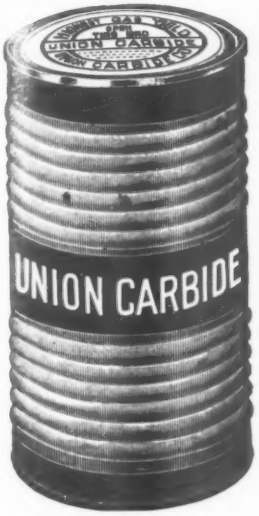

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Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

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CONNECTICUT
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Omaha—1007-9-11 Jones St., Union Sta. P. O.
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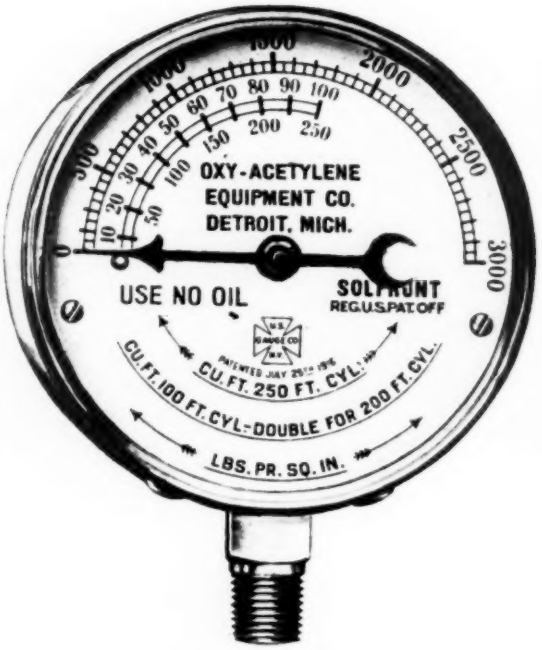
Camden—West and Clinton Sts.
Jersey City—554-56 Henderson St.
NEW YORK
Albany—Montgomery and Colonie Sts.
Binghamton—21 Jarvis St.
Geneva—Exchange St. and Railroad Pl.
Jamaica—11 New York Ave.
Kingston—O'Neil St., near Broadway.
Niagara Falls.
Poughkeepsie—Smith St. and N. Y., N. H. & H. R. R. Tracks.
Roscoe.
Utica—135 Hotel St.
Watertown—438 Court St.
Whitehall—22 Main St.
NORTH CAROLINA
Wilmington—Room 16 Masonic Temple, 13 N. Front St.
NORTH DAKOTA
Fargo—17 Broadway.
OHIO
Cincinnati—63-65 Plum St.
Cleveland—601 The Citizens' Building.
Columbus—330 Dublin Ave.
Dayton—812-828 E. First St.
Lima—338 East High St.
Toledo—414 S. Erie St.
Zanesville—Main and Second Sts.
OKLAHOMA
Oklahoma City—27-29 E. Grand Ave.
OREGON
Portland—Fifteenth and Hoyt Sts.
PENNSYLVANIA
Beaver.
Du Bois—Weber Ave. and Franklin St.
Erie—1426 Chestnut St.
E. Greensburg—Clark and George St.
Harrisburg—25 S. Tenth St.
Johnstown—129 Jackson St.
Pittsburgh—1202 Chamber of Commerce Building.
Pottsville—Railroad and Sanderson Sts.
Scranton—Penn Ave. and Vine St.
Shamokin—5th and Walnut Sts.
Williamsport—Canal and Court Sts.
SOUTH CAROLINA
Charleston—153 Church St.
TENNESSEE
Chattanooga—700 E. Tenth St.
Knoxville—426 West Depot Ave.
Memphis—671 South Main St.
Nashville—105-107-109 Broadway.
TEXAS
Dallas—802-810 Cadiz St.
El Paso—900 E. Overland St.
Houston—Baker and Cedar Sts., Box 745.
San Antonio—Cor. Leal and N. Salado Sts.
Waco—13th and Mary Sts.
UTAH
Salt Lake City—118 W. Second South St.
VIRGINIA
Lynchburg—1324 Commerce St.
Norfolk—513 Front St.
Richmond—18th and Cary Sts.
WEST VIRGINIA
Bluefield—195 Roanoke St.
Charleston—Broad St. and K. & M. R. R.
Fairmont—"A" Street.
Huntington—820 3rd Avenue.
WASHINGTON
Seattle—1103 First Ave.
Spokane—646 Peyton Building.
WISCONSIN
La Crosse—Front and King Streets.
Madison—513-19 Williamson Street.
Milwaukee—120-134 Jefferson St.

We recommend our customers to select from the list, the city from which the quickest delivery and lowest freight rate can be obtained, and address their orders to "Union Carbide Sales Company" at the distributing point selected accompanied by remittance.

Please address request for information or special correspondence to either the New York or Chicago office.

SAFETY FIRST



Patented July, 1916

OXY-ACETYLENE GAUGES

for

WELDING and CUTTING APPARATUS

United States Gauge Co.

67 Wall St., New York

WORKS:
Sellersville, Pa.

BRANCHES:

Clark St. Bridge
Chicago, Ill.

42 W. Larned St.
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681 Market Street
San Francisco

Board of Trade
Montreal, Can.

Fyber-Weld
Goggles for Welders

fitted, when desired, with "Essentialite" Lenses

Frame is made entirely of vulcanized fibre, and in addition to being light in weight is a non-conductor of heat and electricity, is non-inflammable and infusible, is not affected by moisture or perspiration and is easily sterilized and kept sanitary. Has flexible leather center, ventilated side pieces and adjustable elastic headband.

No. 510. With "Essentialite" lenses. Per pair..**$3.00**
No. 510. With plain, clear lenses. Per pair.... **2.50**
No. 510. With amber, smoked, green or cobalt blue lenses. Per pair..... **2.50**
Extra cover glasses, per pair..... **.10**

"ESSENTIALITE" LENSES

To those of our patrons who are not thoroughly conversant with the real qualities and benefits of **"Essentialite"** lenses, we take pleasure in furnishing the following information. In placing the **"Essentialite"** before the trade, we have, after years of experimenting and research, succeeded in discovering the means of protecting the delicate organism of sight against the destructive Ultra Violet rays. We have demonstrated conclusively that with these lenses we vanquish the so-called "fatigue-weariness" and headaches caused by Ultra Violet and Infra Red rays.

The word **"Essentialite"** will become universally the synonym and adjective of a certain grade and color which has the peculiar quality to eliminate the above mentioned troubles. The special green-amber tint will accomplish everything that is claimed for it. While becoming famous for its beneficial qualities under the name **"Essentialite,"** we notice certain goggle makers and dealers endeavor to individualize, and claim to control as their own product, certain imitations. We, therefore, advise our patrons when ordering to please specify **"Essentialite"** lenses, the exact glass for oxy-acetylene welding.

Manufactured by

Chicago Eye-Shield Co.

2300 Warren Ave., Chicago, Ill.

Universal All-Steel Welding Truck

A time-saver and convenience which no progressive welding shop can afford to be without. Made in two sizes; to carry two 100 ft. drums, and to carry two 200 ft. drums.

Truck is equipped with torch hooks on which the torch can be conveniently placed when not in use, and a ten hole tip rack. The welding rod supply box is made to carry eight pounds of welding rods. The supply case, spaced off into compartments, will carry two one-pound cans of flux, cutting tips, adaptors, goggles and wrenches.

The truck has a hand wheel drum tightening device, strongly constructed, and so made that the drums are held tightly, eliminating any shaking when the truck is in motion.

The entire truck is constructed of heavy angle iron, and has a 10 gauge steel platform. It is so constructed that when fully loaded it will balance easily, facilitating rapid transportation. WRITE FOR PRICES TODAY

UNIVERSAL OXYGEN COMPANY : Sheboygan, Wisconsin

Milwaukee Branch, 554-556 E. Water St.

High Silicon Cast Iron Welding Rods

Atlas Quality

Also rods, wires and fluxes for welding all metals. Quality guaranteed.

Prices Cheerfully Quoted.

ATLAS FOUNDRY CO.
IRVINGTON, N. J.

Attention, Gas Manufacturers

We manufacture cutting equipment for the following gases:

Acetylene, Carbo-Hydrogen, Hydrogen, Thermoline, Artificial, Rock gas and Natural gas.

Also, Welding equipment.

With your name plate attached if desired.

Our factory is the best equipped in the country for quantity orders.

No goods retailed.

Harris Calorific Co.
2828 Washington Ave. CLEVELAND, OHIO
Send for circular

There's Profit in a Good Welding Outfit

The better the tool, the better the work.
The better the work, the greater the demand for it.
The greater the demand, the more volume and the more profit.

VULCAN

Oxy-Acetylene Cutting and Welding Outfit

is the most efficient. No job too big or too small. No outfit is so economical, so reliable—it cannot be surpassed.

A Vulcan Outfit will be highly profitable for you. But be sure you get a Vulcan.

Send for full information. Ask for catalog W-1.

Air Reduction Sales Co.
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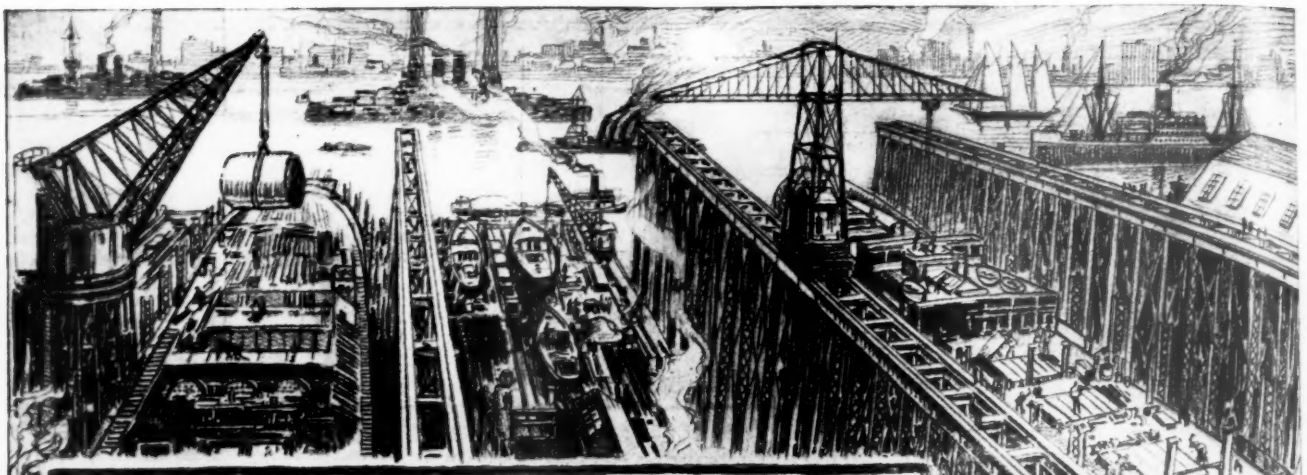
Clean and Quick Method of Brazing

B. D. M. Co.'s No. 101 Gas Brazing Stand for tool rooms or manufacturing purposes, has two powerful gas blowpipes which are adjustable in any direction. The substantial iron frame carries also an air drum and necessary connections as illustrated. Equally effective for a small piece of soldering, or for a heavy job of brazing requiring both blowpipes and a built-up fire-brick backing. Price, $40.00. Catalog "B. X.," to be had for the asking, tells all about it.

Buffalo Dental Mfg. Co.
Buffalo, N. Y.



Simplified Arc Welding Equipment Now Ready to Demonstrate

Before ordering your welding equipment investigate the General Electric Company's novel welding system. Some of its points of superiority are:—

1. Constant Energy.
2. Shortest known arc.
3. High efficiency.
4. No resistance in series with arc.

By the use of this equipment good operators are producing consistently perfect welds.

We are prepared to demonstrate this equipment and make good deliveries.

GENERAL OFFICE
Schenectady, N. Y.

GENERAL ELECTRIC COMPANY

Showing the Model A gas burning Wiederwax Preheater in use. Two men are working at one time on different castings while other pieces are seen to be heating in the meanwhile.

100 PER CENT PROFIT

The man who skimps on his operative machinery never rides in a Rolls-Royce. He is too short on profits at the end of his fiscal year. Shop efficiency means better work and more work; it means minimum overhead and minimum operating expense; it results in more customers and more profit.

If you doubt that, look around you. Enter a big factory anywhere—a factory that is making money; note its equipment, and learn the lesson it teaches.

THE WIEDERWAX PREHEATER

is the preheating machine destined to lift practical welding out of the slough of uncertainty and ineffectiveness. It is a continuous heating medium, using natural or artificial gas or gasoline for fuel, working approximately twice as fast as charcoal fires, and allowing one, two, three, or even four men to work steadily, each welding a piece that requires a different degree of heat from the other. Its patented cooling oven cools finished work in half the time required by the "burying" process, without the slightest attention or trouble.

SAVES ITS COST TWICE A YEAR

or, in other words shows a return of 100% on the original investment. And this is putting it conservatively, for in some shops, the Wiederwax Preheater has saved its cost in two months. This means a "turn-over" of six times a year, or a 500% saving—and every saving means a profit.

SOUNDS LIKE A SOLID BUSINESS PROPOSITION, DOESN'T IT?

Then clip this coupon and mail it today. We send you a FREE illustrated booklet filled with facts and figures.

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Please send me free booklet:
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DIG!

This big, tired trench-digger may represent the blue star in *your* service flag—or the star in your neighbor's flag. ★ He is someone's boy—and Uncle Sam's. But he's digging—under fire—for you. And you will want to dig deep for him. ★ Buy your bonds as though he were *your* boy.

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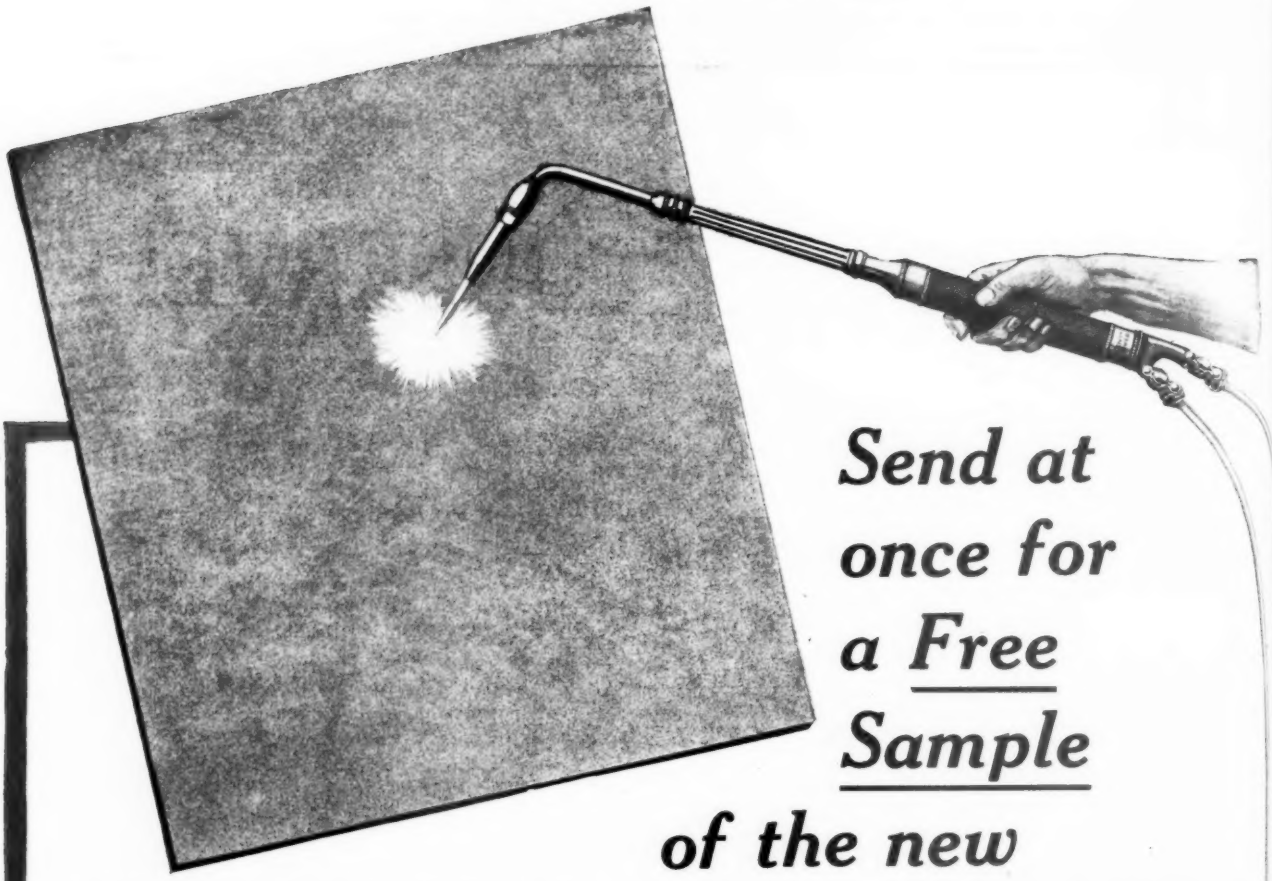
SPEED UP! CONSERVE!

REGO welding and cutting apparatus conserves labor and oxygen. It speeds up production. **REGO** torches cannot flash. They operate on lower combined pressure than any torch heretofore constructed. By eliminating the costly flash-back and using low oxygen pressure **REGO** torches increase production and reduce cost. An absolute guarantee of money back after trial and test in your shop.

BASTIAN-BLESSING COMPANY
West Austin Avenue at LaSalle St.
CHICAGO



Send at once for a Free Sample of the new

WELDOX

ASBESTOS WELDING PAPER

It's especially made for you — for the welder, not for the casting. Not the ordinary paper manufactured for many uses, but a scientifically prepared, long-fibre, pure asbestos paper developed for one purpose — to furnish a welding paper capable of withstanding hard usage and high temperatures without giving off noxious and injurious smoke, gases and fumes. Your men naturally can do better work when WELDOX Asbestos Welding Paper is used on every welding job.

WELDOX Asbestos Welding Paper comes in 50 lb. and 100 lb. rolls, 36 inches wide.

Test the Free Sample with a torch. Subject it to physical tests. "WELDOX" in your shop and available for every job will save in many ways: It lasts longer; it cuts out eye and lung sore for the welders; it therefore aids in turning out better work in less time.

Write for Sample Now

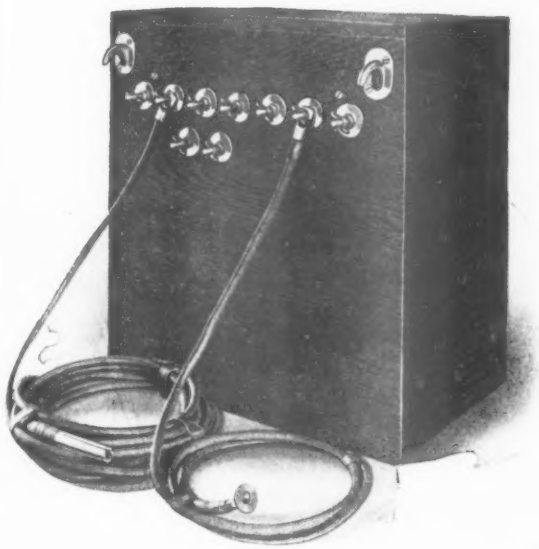
F. D. Farnam & Co.

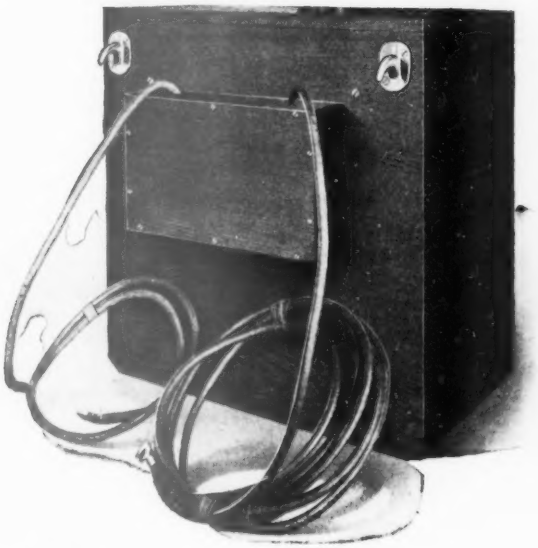
F. D. FARNAM G. E. HARVELL

140 South Dearborn Street, Chicago, Ill.

Asbestos Mittens, plain.
Asbestos Mittens, reinforced.
Asbestos Mittens, plain, one finger and thumb.
Asbestos Mittens, reinforced, one finger and thumb.
Asbestos Mittens, riveted faced.
Asbestos Mittens, 23-inch length over all.
Asbestos Gloves, 5 fingers.
Asbestos Leggings, 16-in. to 30-in. length.
Asbestos Aprons, made to specifications.
Asbestos Masks.

Announcement
of
The Mephisto Welder
Alternating Current Arc Welding and Cutting Machine





LOW FIRST COST

No Motor Generator Set
Weight 300 lbs.
Size 26"x27"x18".

Air Cooled.
No External Resistances.
No Moving Parts.

Efficiency over 90%.
Power Consumption (4 k.w.)
No Regulating Panels Required.

Machines built for either 220-440 or 550 volt a.c. circuit of any frequency.

Machines can be supplied in any size in multiples of 75 amperes.

IMMEDIATE DELIVERY OF STANDARD 150 AMP. MACHINES

We offer the services of our engineering department without charge on special welding problems.

The Arcwell Corporation

42 Broadway **New York City**

Keep Your Liberty Bonds

HOLD to that bond. You invested to help send the boys across. They are over now, at grips with the German monster. You expect them to hold on—hold on till the last vestige of autocracy is crushed out of him. Then you, too, must hold on—must keep your enlisted dollars invested on the fighting line.

It isn't the hooray of a campaign that wins a war. It's the will to hang on, to make sacrifice today that tomorrow may bring victory.

And your investment. Those bonds are the safest investment you ever made. Don't be lured into exchanging them for the "securities" of some suave get-rich-quick operator. Big returns may be promised. but the bigger the promised returns the bigger the risk.

If you have to have money, take your bond to any bank and use it as collateral for a loan. There is no security the banker would rather have — nothing on which he will lend more willingly.

Don't use bonds to buy merchandise. The average merchant, accepting your bonds in trade, sells them immediately, thus tending to lower their market price and taking away from the buyer of your bonds the ability to lend a corresponding amount of money to his Government. Liberty Bonds are meant to help your country at War; are meant for investment and to provide an incentive for saving and a provision for the rainy day.

Hold fast to your Liberty Bonds. Hold fast for the sake of the boys "Over There." Hold fast because it is good business.

UNITED STATES TREASURY DEPARTMENT

Contributed through Division of Advertising
United States Government Committee on Public Information

WELD TRADE A MARK CAST

Stands Alone

For Efficiency As An Oxy-Acetylene Welding Flux

Write for Free Samples
and Be Convinced

CORTLAND WELDING COMPOUND CO.
CORTLAND, N. Y.

Welding Pincers

Use up the short pieces of Welding Metal

This pincer enables the welder to use up his strips of metal almost to the end, all the time keeping his hand a good distance from the heat.

The handle is always cool, no matter how short is the piece of welding metal.

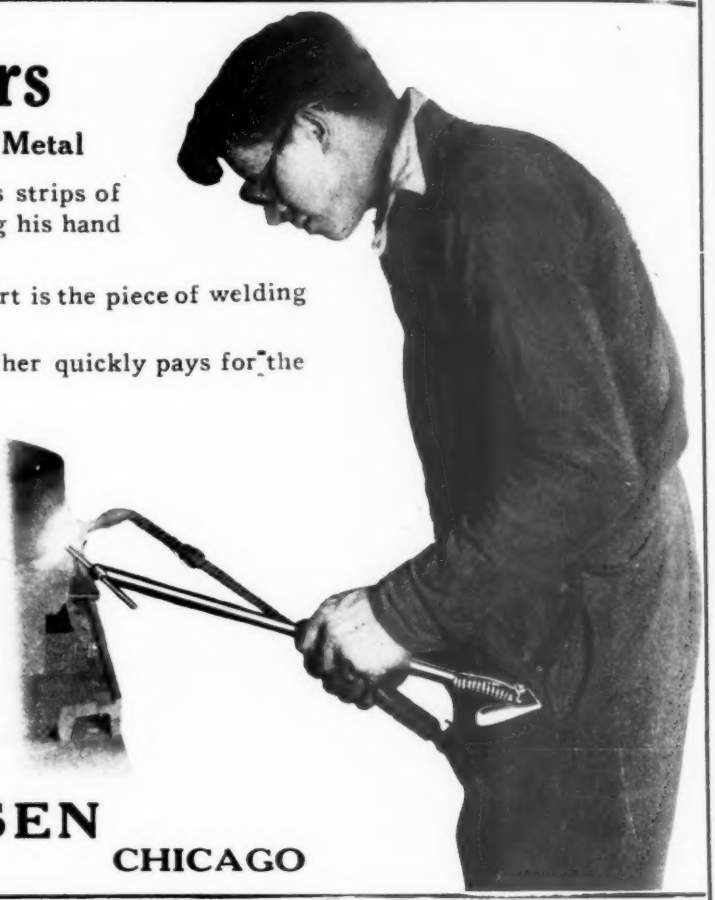
The time saved in welding the strips together quickly pays for the pincers.

Pressing the spring handle releases the jaws to pick up the metal. Length of pincers, 19 inches. Holds rods of 3-16-inch to ½-inch diameter.

Price $1.00

One sent to the address of any Welding shop for 30 days' trial, on receipt of $1.00. If not satisfied money will be refunded on return of pincers.

Jobbers and Agents, write



C. SORENSEN

18 E. 16th St. **CHICAGO**

Swift Oxygen

For Welding and Cutting

Unsurpassed for Quality

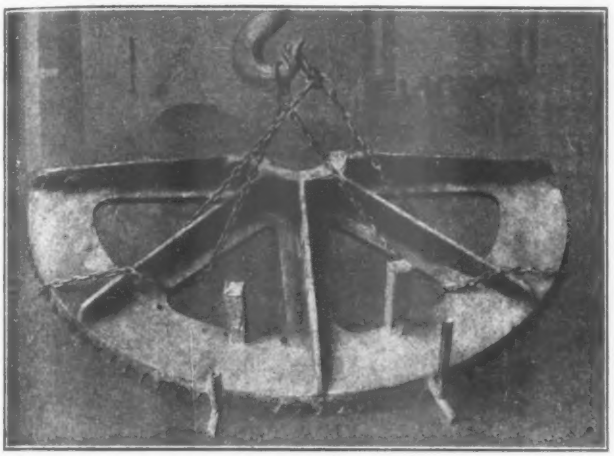
Pure Oxygen Electrolytically Made under the direct supervision of our Chemical Laboratory. It is carefully controlled by chemical analysis, thus insuring the highest obtainable purity.

We carry a large stock on hand so can fill orders immediately.

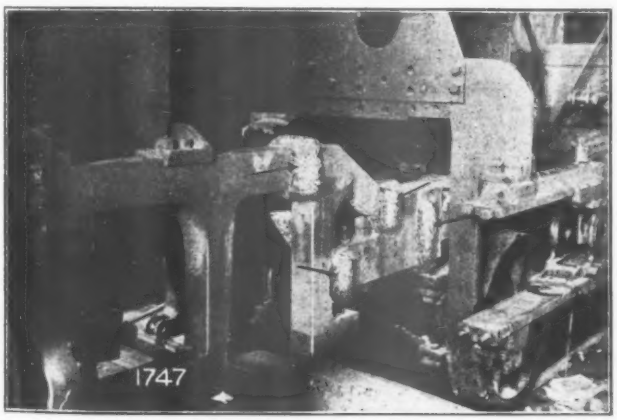
Swift & Company

Oxygen Department **Union Stock Yards, Chicago, Ill.**

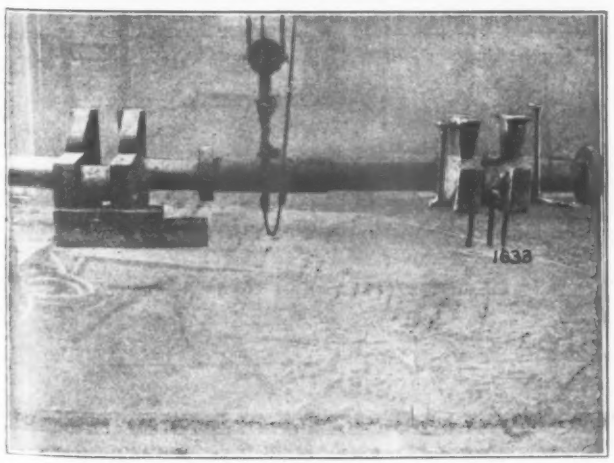
New neck cast on to large roll made with the aid of Thermit and having the pods cast in at the same time.



Large bevel gear on which two new teeth and crack have been repaired.



Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.



New crank pin welded in by the Thermit Process.

THERMIT

The Only Reliable Process for Welding Heavy Sections

THIS Explains Why Railroads and Steel Mills Used Over One Million Pounds of Thermit in 1917. Also Why 95% of the Railroads in the United States and Canada Having Over 10 Locomotives, Use Thermit for Welding Frames and All Heavy Sections.

There are few machine parts which are subjected to greater strains or more severe shocks than a locomotive frame or a blooming mill pinion. Yet Thermit welds on such parts are being made every day and STAND UP IN SERVICE FOR YEARS. The reason for this is that, unlike ANY OTHER WELDING PROCESS, the steel to make a Thermit weld is produced IN BULK at a temperature of 5000° F. Furthermore, results are not dependent on the individual skill of the operator.

We have ample proof for all our claims and our long list of satisfied customers who come back week after week, month after month, and year after year for MORE THERMIT is a never ending testimonial to the efficiency of the Thermit Process.

Remember that Thermit should not be confused with either oxy-acetylene or electric welding. It stands in a class by itself. It welds sections which cannot be successfully welded by any other method.

Let us tell you more about it. Write for pamphlet No. 1779.

* * * *

Metal and Thermit Corporation

(Successors to Goldschmidt Detinning and Goldschmidt Thermit Co.)

The Equitable Building
120 Broadway, New York

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BURDETT OXYGEN COMPANY

AND ASSOCIATED COMPANIES

ELECTROLYTIC OXYGEN and HYDROGEN - 99 1/2 % Pure

Service from the following BURDETT PLANTS

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Logansport, Ind.
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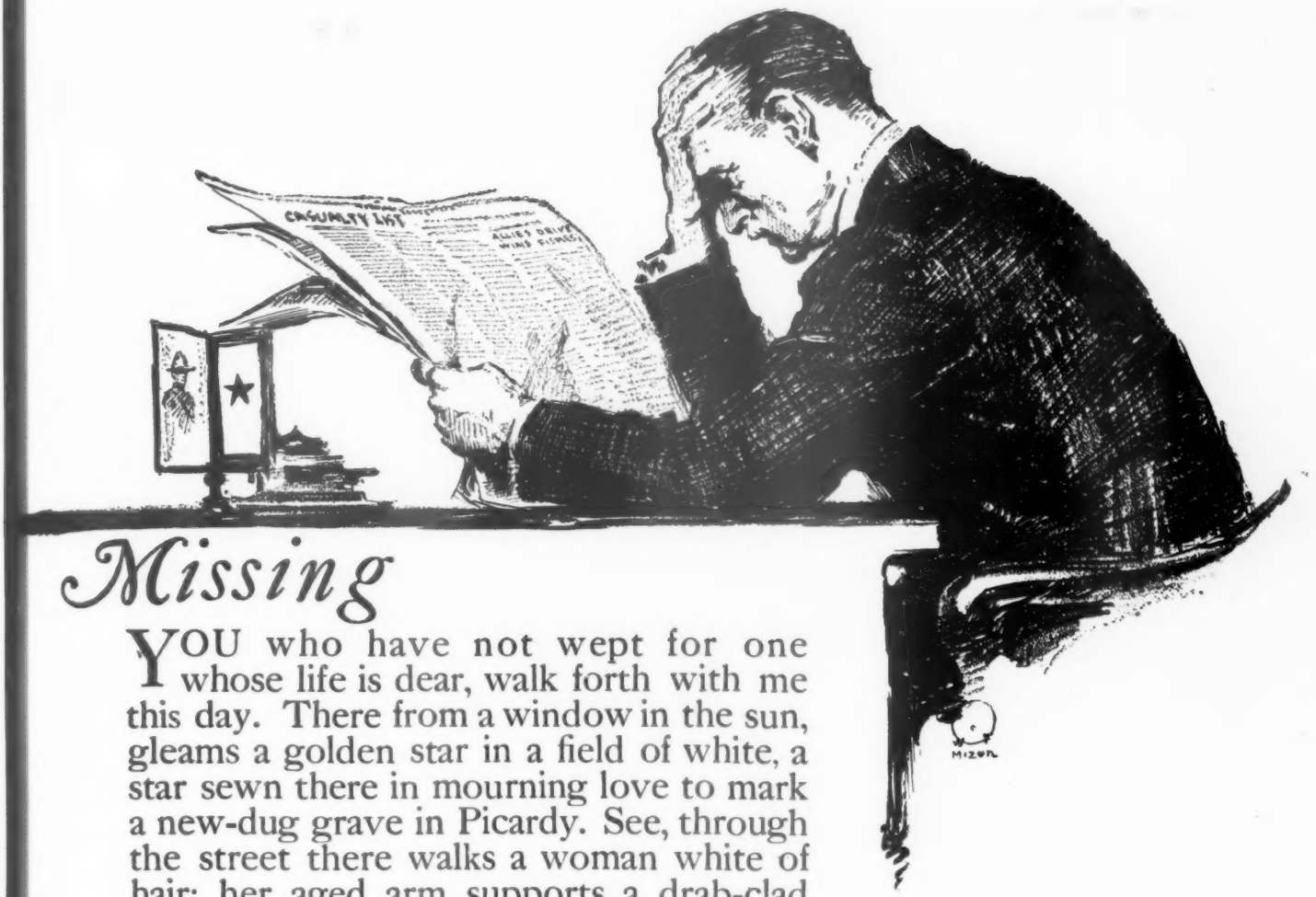
The Largest Producers of the Purest Oxygen in the World



Missing

YOU who have not wept for one whose life is dear, walk forth with me this day. There from a window in the sun, gleams a golden star in a field of white, a star sewn there in mourning love to mark a new-dug grave in Picardy. See, through the street there walks a woman white of hair; her aged arm supports a drab-clad boy, yet in his teens, as with falt'ring step he gropes his sightless way. At an office desk a man, not different from yourself, sits with bowed head and harshly sobs over the day's newspaper where his prescient finger found his son there listed with the "missing." ¶ You who have not wept for one whose life is dear, give utmost thanks that yours have yet been spared to serve the common cause of right. Give utmost thanks that though you may not walk their fields of death and face the peril you fain would share, that of your bloodless treasure you may make an ally that will speed their cause and yours. The day's duty is that you buy War Savings Stamps; that you affix your name on Pershing's Honor Roll as one who has fulfilled his part. So, buy these stamps today.

SAVE
W.S.S.
WAR SAVINGS STAMPS
ISSUED BY THE
UNITED STATES
GOVERNMENT
SERVE

Maximum number of $5 War Savings Stamps that may be purchased by one individual during 1918 is two hundred. During August this represents an investment of $838.00. Buy this full allotment if possible—if not, as many as you can. Let the Pershing Badge signify that you have bought to the limit of your power.

War Savings Committee for Illinois, 403 Conway Building

Insure Your Welds

THE best insurance a welder can have that his welds will be sound and free from craters or blow holes is to use a good flux, made scientifically by chemists who understand the needs of the welder.

The object of a cast iron flux, or in fact any flux, is to eliminate the **OXIDE** and other impurities which form on the surface of the weld, caused by the heat and combination with oxygen of the air. The reactions are the same as in a blast furnace or cupola and flux is used to **CARRY OFF THE SLAG.**

BLACK DIAMOND Cast Iron Flux, when dropped on the molten surface of the weld, instantly clears the metal of iron oxide and other foreign substances, leaving a clear, mirror-like surface, which enables the metal to run together. This condition makes a sound weld.

A very small amount of **BLACK DIAMOND** Cast Iron Flux is required to assure a good weld. The price is a secondary consideration—it's the quality that counts.

Put up in 2 pound cans $1.00 per can

Chicago Welding Compound Co.

Transportation Bldg. **Chicago, Ill.**

Our Service Department is at your service.
Consult us about your flux troubles.

Good Flux Is Necessary

AN Aluminum break when melted does not flow together as other metals do, but the edges creep away from each other. There is a film on the surface, dull grey in color. This film is **ALUMINUM OXIDE.** It must be destroyed before your weld can be a success. By using **RED DIAMOND** Aluminum Welding Flux the aluminum oxide is instantly destroyed and the metal assumes a bright silvery appearance. By adding **RED DIAMOND** Flux with the hot welding rod, in the usual way, not only does the aluminum oxide disappear, but dirt and grease as well.

A trial can of **RED DIAMOND** Aluminum Welding Flux will convince you that this is the flux you have been waiting for.

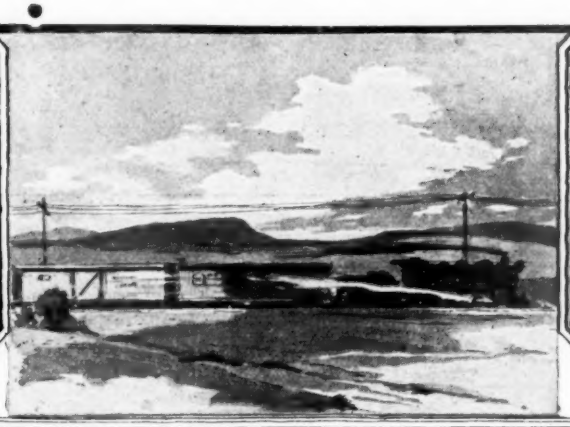
Put up in 2 pound cans $3.00 per can

Chicago Welding Compound Co.

Transportation Bldg. **Chicago, Ill.**

Our Service Department is at your service.
Consult us about your flux troubles.

SAN FRANCISCO



NEW YORK

A Simple Plan That Works

FOR the manufacturer, the difficulty of obtaining important supplies under abnormal conditions does not lessen as time goes on.

If he does his share in maintaining Linde Service, he is able to meet these conditions as regards one highly important item—Oxygen.

The matter of promptly returning empty cylinders is becoming one of increasing importance. Not all manufacturers appreciate how particularly vital it is in times like these.

Some of the largest consumers of Oxygen make use of a very simple system that enables them to tell at a glance the daily oxygen consumption, whether more should be ordered, and how many empty cylinders are waiting to be returned.

Manufacturers now paying a rental charge for cylinders could, by adopting such a simple system, save money.

If you care to see the details of the plan, we will gladly send them on request. A plan that is helping others may very well help you.

The Linde organization from coast to coast has never been so well equipped to render the intelligent service which is the ambition of everyone in our employ, but Linde Service with its hundreds of thousands of cylinders demands your cooperation.

Help us to help you by returning the empties promptly.

The Linde Air Products Company

The Largest Manufacturers of Oxygen in the World

42nd Street Bldg., New York City

IS WELDING A TRADE?

Recent Ruling of Director-General of Railroads, Classifying Welding Work, Brings Criticism From Many Sources.

By Nels Johnson

MANY years ago history tells us, there lived a man by the name of Solomon. He was King of the Jews and was considered to be very wise, in fact, the wisest man of his age.

One day while he was erecting the great temple in Jerusalem, he went around inspecting the work. He first came to a gang of men digging sand and he asked them, "Men, who made your tools?"

They answered him, "The Blacksmith." He then came to the stone cutters and he asked them among other things, "Men, who made your tools? He got the same answer, "The Blacksmith." So the story says he went around visiting all his workers asking the same question and receiving the same answer.

He finally came to a building where men were working around fires and pounding red hot iron with big sledges shaping it into different kinds of tools, etc. He then asked a big fellow with brawny hands, "Men, who made your tools?" The men looked at him and said, "We did ourselves. Who else should? We are the Blacksmiths." King Solomon then called the Blacksmith trade the King of All Trades.

Many years have passed since the days of King Solomon, many improvements have been made since his time, in fact, improved methods are coming so fast in later years that it is hard to keep track of the latest, even in one's own trade.

The Blacksmith no longer makes everybody's tools. The old Blacksmith trade has branched out to many trades; Machinist, Boilermaker, Molders, etc., and in each individual trade the work is now divided so that one man does only a certain kind of work running a certain machine or performing some other operation. Thus the work is passed from man to man until finished, and brought to the mechanic whose duty it is to assemble and put the different parts together.

We all agree that it would not prove very satisfactory if mechanics repairing a locomotive engine should make their own forgings, turnings, planing, drilling, etc., and do boiler work besides if needed. The specialized system is proven to be the best. It is the only practical and economical way.

If the blacksmith trade was the king of all trades in years gone by, I believe that the welding trade is the king of all trades today; although I admit that it has not as yet come into its own. There are some obstacles in the way, which in my opinion hampers its development and should be removed and adjusted.

When the oxy-acetylene and electrical welding were introduced and put into practice in the railroad shops the mechanics of the different trades saw that by this new method one man could perform as much work in one day, as it would, in many instances, take several men many days to perform.

The matter was discussed greatly in the different Labor Organizations and all came to the conclusion that we must get control of that work because if not the members of our craft will have a hard time to find work in the near future. The Blacksmith saw the work drift away from him and claimed the new process of welding as belonging wholly to his trade because of the fact that all welding of iron and steel belonged to his trade in the past. The only difference would be to bring the man to his work whether it be in the machine shop or round-house or elsewhere, instead of bringing the work to the Blacksmith shop.

The Machinist claimed that the Blacksmith never welded cast iron. A broken casting would as a rule have to be replaced by a new one and it took a machinist to shape and fit such castings.

If an engine frame were to be welded it took the machinist several days to take the frame down and after it was welded it had to be machined and put back by machinists. For that reason they claimed to be as much, or more, entitled to the frame welding as the Blacksmith.

I could mention such instances by the hundreds. It was and is now an entire impossibility to decide which of the two crafts should do the work if it had to be divided so that each craft should do their own work by the new welding method. However, the jurisdictional disputes about the welding were settled among the different crafts in this way; it was decided that the welding torch is only an improved tool and that each craft could use that tool on any work formerly done by the craft.

This may sound reasonable and fair to anyone who has not studied the work. It was so ruled in fairness to all crafts and in the order from Director General of the Railroads it was so ruled because the committee representing the men wanted it that way and because it had been that way before. Mr. McAdoo and his advisors no doubt meant to be fair and just to all but I for my part must disagree with them, and I note in the August issue of *The Welding Engineer* that others do the same.

The new welding process is a trade of its own and should be so recognized.

In any other trade it is required that a certain length of time must be spent learning the trade, as a rule three to four years before the apprentice is recognized as a mechanic and before that time expires full pay is not given. It is generally believed by those who have little or no experience in welding that welding is learned in a few days or a few weeks at the most. Such a theory is wrong unless a man is called a welder as soon as he is able to fill in metal in a hole, or a worn spot on something. Welding is a trade that must be studied and practiced a long time before one learns and understands the work. I have reference to oxy-acetylene welding only, electric welding I know nothing about.

The greatest obstacle in the way of the welding trade is the unskilled mechanic. The method, not the welder, is as a rule blamed for failures, although as a matter of fact 90 percent or more of all failures should directly or indirectly be laid to the operator. If the welding is to be split up and divided

among a half dozen different trades it is going to spell failure, at least there will not be the results that they now have in shops where the welding is under one head.

Welding should in my opinion be under one head wherever five or more welders are employed, and a man who understands welding be in charge. There are very few railroad shops in the country where this is done.

Men learning the welding trade should serve time and during the apprenticeship be instructed in all branches of the trade. By getting a chance to work on all kinds of work, the locomotive boiler, frames, cast iron and steel castings of all description, brass, copper, etc., he will get a broader view and better understanding of metals. He has a chance to become a welder.

In a large shop where many welders are employed it will perhaps be found that a certain man can do boiler work a little better than the rest, and not be quite as good at some other work. Another operator might be the best frame welder, but this fact is the same in all trades, and it is also a fact that some will never be any good at all, although they may be good mechanics at some other class of work. It will be up to the foreman in charge to place the operators mostly on such work where they do the best.

The welders should organize and demand recognition as a trade. It is the only way to get the welding to one trade of its own. If we do not organize ourselves no one else will do it. It will benefit not only the welding industry as a whole but the employer as well as the employee will be benefitted. Let us do away with a system that has neither head nor tail and make the welding the King of All Trades.

THE ARMY LECTURE COURSE.

Comments On Answers.

By Lieut. Lorn Campbell, Jr., Ord. Dept., U. S. A.
Officer in Charge of Welding, Peoria, Ill.

An extremely difficult problem confronts the person that attempts to make answer to the apparently conglomerate number of questions which pertain to Oxy-Acetylene Welding and cutting processes; the care, operation and repair of the apparatus involved. The reason is quite evident; the objects of the questions are not known.

It is therefore not at all surprising that a certain welder who was courageous enough to attempt the task of answering the set of questions, recently published, had some difficulty in so doing and only gave the answer desired to approximately one-half of the questions. These questions form sort of an index in the Ordnance Welding School, to see whether the student welder assimilates some of the points brought out by the instructors in shop work and chalk talks or lectures which accompany the course.

To be sure there were many ambiguous as well as catch questions purposely installed to keep the student thinking for himself. What good is a welder, or for that matter any person who learns "poll-parrot" fashion and refuses to think for himself? The purpose of the whole course is lost then and it is just this point that is trying to be avoided by the introduction of these questions and the students' own ideas in expressing his answers. Being written up as they are, serves a two-fold purpose. They let the instructors know whether the students have gained the points they wish, and are thinking for themselves and it also serves to let the instructors know whether they are making these points clear enough for each of the students. If the chalk talks and lectures can be associated with the shop work in such a way that the student can readily see the relation; much more ground can be covered in a far shorter period than would be otherwise possible. In learning most trades, the apprentice starts in by sweeping the shop floors and cleaning up in general and very gradually picks up all the points. He may continue this for perhaps three or four months before he gets a real chance to handle the tools for himself. This is true of Welding as much as any other trade and it is perhaps six months before the beginner will have an opportunity of making a cast iron weld, let us say, that can be depended upon. This sort of training is all well and good but it is not intensified enough for use in the Welding School. The training is very intensified in the latter case, and the student taught, as he goes along, the "Whys and Wherefores" of each movement and all the little tricks and helps that have been taken from many shops rather than any one in particular. It is therefore possible to train a welder in a very short time if a systematic procedure is followed. It is unnecessary of this welder, however, to point out, in many cases, as he does that "Question ..... has no bearing on Welding." Let it be thoroughly understood that each and every question was thoughtfully inserted by the officers in charge of instruction for a purpose and they are all used to turn out the most efficient welders possible for the Army in the time given.

While there are many ambiguous questions throughout the course, there are, however, a few questions which are undoubtedly stated very clear and which justify a clean cut answer. Even though with a number of these, this welder's answers might be changed a little, for example:

Lecture No. 2, Question No. 5. Describe briefly the working principles of the Regulator and illustrate with a simple sketch.

Answer No. 5. The high pressure gas enters at H through the nozzle F, into the chamber M. The yoke E, which is fastened to the diaphragm D, and has on its lower end a seat S to close F is held down by the pressure of the spring C, which has been compressed by the adjusting screw A acting on the washer B; so when the gas pressure in M is sufficient to equal the spring pressure, it will push up the diaphragm, and with it the yoke, and the seat S will close the nozzle, shutting off the supply. The gas, at reduced pressure, passes out through K. As the gas in M is used up, the process is reversed. (See sketch—Fig. A, Page 16, May, 1918 issue.)

Comment

The sketch as outlined is not a regulator for a regulator must have a flexible diaphragm which will move with the action of the gas. The parts A and E as shown in Figure A should not be connected by any solid matter as shown. The diaphragm D should be entirely dependent upon the action of the spring C for its external force.

Lecture No. 8, Question No. 10. (a) What would be the trouble, in shutting off a welding plant, if there were a reading on the high pressure gauge and none on the low pressure gauge, after permitting gas to escape from the hose?

(b) How could the reading on this gauge be brought back to zero?

Answer 10. (a) The hand would have moved on the center spindle.

(b) Remove the hand carefully with a pair of pliers, and replace it with the pointer end just resting on the zero pin when there is no pressure on.

Comment.

This undoubtedly is an experience which comes into every welder's life when he is beginning and it is to avoid the impression that the gauge is at fault that this question was inserted. When a pressure is indicated on the pressure gauge, when the gas has been drained out of the hose, it is undoubtedly a pressure showing between two weld working

seats, namely the cylinder valve and the regulator seat and in order to lower this pressure, it is only necessary to screw in the cross bar, or in other words put pressure upon the diaphragm springs on the regulator. This will permit the trapped gas to escape and the gauge will return to normal.

Lecture No. 9, Question 4. (a) What kind of a "filler-rod" is used in welding steel?

(b) Give the general rule covering relations of "filler-rod" to the metal being welded in all cases, but one and two.

(c) Name one exception.

Answer 4. (a) All kinds of material are used, from electric furnace iron to 40 carbon steel; also many alloy steels such as vanadium, nickel, etc.; Swedish iron is also largely employed. Which of them is the best, the writer does not feel called upon to decide. He does believe that different conditions may make it advisable to use different materials. No published tests, that he has seen, give any accurate or reliable comparisons, and the subject needs careful investigation.

(b) The question is not clear. Does it mean the kind or the size? If neither of these, what quality is it desired to compare? If kind or size, these questions have been answered. If some other quality, this will have to be known before an answer can be given.

(c) Cannot be answered without further information.

Comment

(a) It is to assist the student when beginning in the choice of his rods that this question is inserted several times in order that he follow a general rule which will assist him in his work. It is true that all kinds of material are used from electric furnace iron to 40 per cent nickel steel in the actual, but in starting a new man, it is necessary to draw a line of distinction. It is considered correct in answering this question to specify a soft iron wire or mild steel.

(b) A general rule to follow in choosing the "filler-rod" for any metal is that the same metal must be in the "filler-rod" as that upon which we are to work. There are exceptions but this is the easiest way of bringing this point out, that is; when working on cast iron, cast iron is used in the filler-rod. When working on rolled stock or dropped forgings steel is used, when working on aluminum, aluminum is used, etc.

(c) When working on malleable iron a bronze is used; when working on cast steel, a drawn iron or steel rod is used.

Lecture No. 12, Question 33. (a) What is meant by a "corrugated" patch for boiler or thin armor plate?

(b) Sketch such a patch.

(c) How is this kind of a patch prepared?

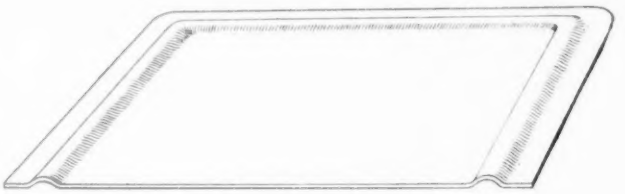
Answer 33. (a) The writer has never used such a patch, but supposes a section of it to be like the sketch.

(b) Sketch (none given).

(c) In the same way as a dished patch, the form being made to suit.

Comment

(a) A "Corrugated" patch is a corrugation extending about two inches from the edge, all around three sides of the patch and differs in this respect from a "dished" patch insomuch that the latter has only one belly, while the corrugated patch has a continuous run on three sides. The reason for the corrugation is quite evident it is to take care of the contraction. The method employed in inserting a patch of this kind is to weld the uncorrugated side, then start up the corrugated side and weld for two or three inches, then play the torch upon the corrugated part and slightly hammer it to assist in the expansion of the same, then return to the weld; continuing it until the corrugation can again be played upon. By doing this, when finished, the patch will be flat and no signs of the corrugation will be in evidence and many patches of this nature are in use, giving the very best of success, while the welder who looks on the finished job cannot decipher how it has been accomplished.



"Corrugated" Patch

(b) Sketch given.

(c) "Corrugation" may be made by placing two rods on one side somewhat separated and between them on the other side another rod. With this section of the patch heated to a red heat a drop hammer is played upon it and a corrugation easily affected.

Question 34. (a) What advantage has a "corrugated" patch over one that is "dished"?

(b) Where are "Corrugated" patches used extensively?

Answer 34. (a) In case of a long, narrow patch, it might be supposed that there would be less strain than with a dished one, but with an approximately square patch, this advantage would largely disappear, as it cannot be corrugated both ways, because of the expense which in any case is a serious objection to this kind of a patch.

The writer has seen a patch twelve feet long and nine inches wide put in the firebox of a locomotive boiler without trouble, and it was not dished or corrugated; it was slightly curved, however, which allowed for the contraction.

The writer doubts that, for general use, a corrugated patch is of any special value; as a dished or curved patch will answer any purpose, if properly made and applied.

(b) Presumably in locomotive fireboxes, where the cracks are usually localized in quite a small area, and where such a patch might be of some value, in certain cases.

Comment

A "dished" patch is somewhat limited to size and shape, whereas a "Corrugated" patch knows no limitation, so far as shape or size is concerned, and its outline can twist and turn in most any direction. The contraction will be taken care of by the corrugation.

18. (a) What difficulty is generally encountered in making a long weld like on a steel tank?

(b) How can this be overcome?

(c) Why do the open ends on sheet steel welds overlap in welding when same class of work on cast iron separates?

Answer 18. (a) The contraction of the weld draws the sheets together at the end opposite to where the welding begins.

(b) By separating the sheets at the far end and the proper amount.

(c) This has not been the writer's experience. He finds that cast iron acts the same as steel.

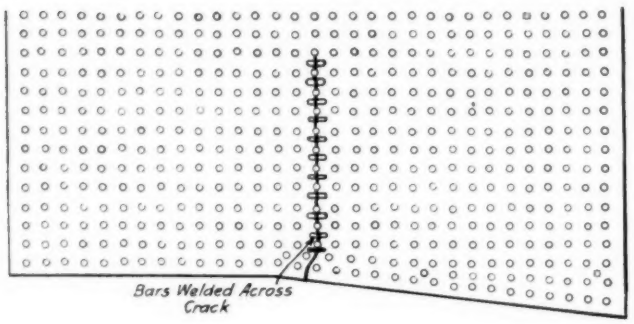
Comment

It is thought that, even though this welder states that no difference exists, that if he sometime avail himself of two thin pieces of cast iron, say 6 inches by 18 (possibly an oven door) that has been cracked and weld from one side to the other, that the results might interest him. It would be interesting indeed to have these published together with the explanation requested.

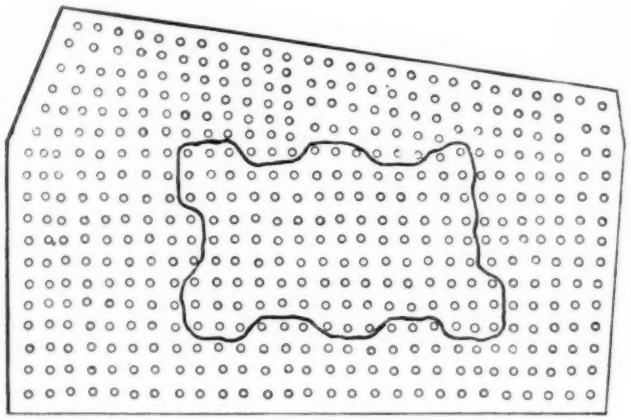
WELDING FIREBOX PATCHES AND CRACKS.

By E. D. Johnson

A great deal of trouble has been experienced in welding firebox patches by either the electric or oxy-acetylene process. It is very difficult to provide for the expansion and contraction in welding straight seams. Often the welder looks his work over admiringly when it is finished and before the gets out of the firebox the contraction causes the seams to break. After experimenting with patches of various shapes in an endavor to overcome the trouble, I have found what I call the serpentine patch to be best.



This type of patch is laid out as shown in Fig. 2. The seams in the stayed surface do not extend in a straight line for more than 12 inches at any point. It is almost always possible to lay out a patch in this way by alternating the seams between different rows of staybolts. The expansion and contraction of the sheet does not cause any trouble where this arrangement is used. Patches made in this way have been in service for three years and have required no attention during that time. When welding in patches it is best to build the weld up flush with the sheet for 6 or 8

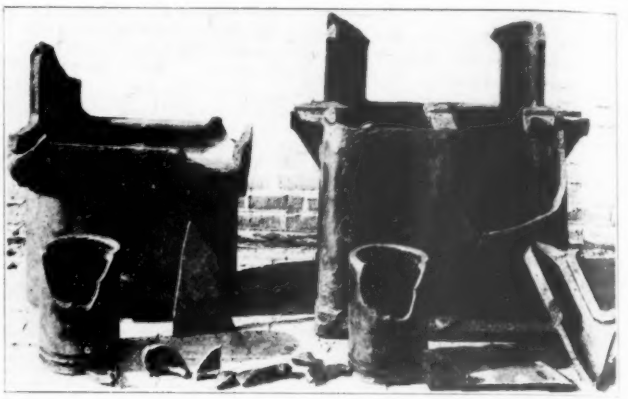


inches, then brush off the oxide which forms with a wire brush and reinforce the weld with not more than $\frac{1}{16}$ inch of metal. No more should be applied because an excessive amount added to the weld results in overheating when the locomotive is in service.

As a rule it is best not to weld cracks over 10 inches long, but where necessary longer cracks can be welded successfully by building the weld up flush with the sheet, then cutting transverse grooves two or three inches apart laying ¼-inch steel rods in the grooves and welding over them for the entire length. In this way the sheet is made stiffer and in addition the rods must be broken before the weld can crack. —Railway Mechanical Engineer.

CHEATING THE SCRAP HEAP

The accompanying illustrations show a very fine piece of welding, by James W. McCartney, Rockford, Ill. This Curtis



Broken Curtis Compressor.

8"x8" compressor was badly smashed, as shown by the illustration at the top. The finished job is shown at the bottom.

Same Compressor After Welding.

One of the most interesting exhibits at the Traveling Engineers' Association convention, held at the Hotel Sherman, was that of The Air Reduction Sales Co., manufacturers of compressed oxygen, acetylene, cutting and welding equipment, and acetylene generators.

This being the first time the company has had an opportunity of displaying their products, their exhibit attracted considerable attention.

The Air Reduction Sales Co. maintain an Educational Service Department for the purpose of acquainting railroads and manufacturers with the latest developments in the oxy-acetylene process.

The exhibit was in charge of Messrs. R. T. Peabody, William McCarthy, W. N. Campbell, of New York City, assisted by Messrs. E. M. Sexton, Ray Sossong and S. H. Shaykin, Chicago representatives.

MY METHOD OF WELDING WITH THE ELECTRIC ARC AND WORK WHICH I HAVE DONE

By Edward D. Johnson*

With nine years' experience as electric arc welder I wish to give those that are interested in welding some information.

First, to get good results you must have an experienced operator, one who thoroughly understands his business, but if you are going to break in your own men you must start them on flat work, such as worn places on frames, spring hangers or any other worn parts of machinery. Keep them on that class of work until they can weld a close, smooth grain; they should never hold the arc more than one-eighth inch from the piece being welded. If they do, they will find that the weld will be oxidized and very porous. When using one-eighth inch iron one should never have more than 60 volts and 125 amperes and with five thirty-second-inch iron 70 volts and 150 amperes is always sufficiently high for heavy work.

I have trained a lot of men and I find it takes from four to six months before obtaining any good results, especially on a job that requires any strain or pressure on them, such as locomotive frames, patches in firebox, flues or tanks. Some people claim they can teach a man to weld in three or four days. This is not so. The trouble with welding is that when a man gets a few months' experience he thinks he knows it all and that there is nothing to it. The majority of them never study the expansion or contraction of a job. It takes years of experience to make an expert welder, and there is always something more to learn. Some men never make good welders and most of them have to be watched, for they get careless at times.

Broken Locomotive Frames

I have welded in my three and a half years in the Grand Trunk Shops in Battel Creek (the main shops of the Western Division) 210 locomotive frames, of which only four failed. The manner in which I lay out and weld my frames is as follows:

First, I have my frame jacked up and drawn together to take the weight and strain off it, then I square it to see how much it is out. I then tram it and lay it off by V'ing it out at each side, allowing 2½ inches for an opening on the outside and no less than ⅛ inch or no more than ¼ inch in the center of the break.

This is then cut out with the carbon electrode, although sometimes the oxygen blow-pipe is used. It is much better, however, to use the carbon electrode, because a smoother and softer surface is obtained to chip off the oxide and slag. Then I tram it again to bring it back in place. Next get a piece of ⅜-inch boiler plate and put it under the break, allowing a lay of, say, ⅛ inch to ¼ inch for reinforcing. Then weld the plate on, put ½ inch up the center of the break, scale them ½ inch more, and scale, so on until the job is done.

In places where there is a bolt hole running through the center of the break it is best to weld the hole up solid. Cut out to the center of the outside of the hole; you will find this will save considerable welding; then have a stud put in instead of a bolt, which will make the weld stronger.

On places where I can only weld a frame from one side, such as up against a cylinder or firebox, I reinforce by getting ¼-inch steel rods, weld them on the outside of frame, then put the first one on ¼ inch from the bottom, then put ¼ inch of metal, then another rod and metal, and so on, being careful to cover the rods until the job is finished. I will guarantee the weld will never break if my instructions are carefully followed.

Crystalized Frames

Where the frames are crystalized, or have had several smith welds, it is a good plan to cut out the piece of the frame, say 2 or 3 feet, or as far as can be allowed. I have welded 17 in this way and they have proven a success. Where there is a patch needed or staybolts renewed on the outside of the firebox behind the frames on the small type of engines, instead of taking down the frames I cut that piece out in order to get at the work, say 2 or 3 feet or more, and after the boiler is tested the piece is welded back, thus saving the company considerable time and expense.

Where a frame is broken over the driving box I weld it through the spokes. I have no wheels dropped unless it is really necessary. I can cut out and weld a four by five in seven to eight hours. I mostly double up, using a man on each side, which will get the frame welded in half the time. We protect our eyes first by letting one man weld the ½-inch center, then get a piece of sheet iron and tack it across the top so that there are no flashes to be had from either operator.

When I was learning electric arc welding I had great trouble with my eyes. I tried all kinds of shields and hoods but finally came to the conclusion that the smoke was more injurious to the eyes than the flashes, so I got a pair of goggles and from then on I had no more trouble. At first when putting on goggles they will sweat, but if heated a little this can be overcome. The glass I use in my shield is a red and blue, and a plain white one on the outside to protect the colored glass from sparks.

Patches in the Firebox

There has been a great deal of trouble experienced with both electric and acetylene welding on account of expansion and contraction in welding square patches and straight seams. I have seen welders sit down and admire their patch and before they got out of the firebox the patch would go off like a gun and scare the man almost to death—four or five hours' work shot to pieces. I have seen an expert acetylene welder demonstrator have the half side crack no less than nine times before he had it finished.

These experiences brought the conclusion that straight lines did not suit me, so I started experimenting on patches of all shapes and found what I call the "serpentine patch" to be the best. These serpentine patches can be relied on to give service and never crack. They are zigzagged over three staybolts and under three, and so on. They have been in use for three years and I have had no trouble with them and I know I will not, because the expansion and contraction looks after itself.

With this manner of welding in patches always see that patch or half-side, or whatever is done in the firebox or boiler, has an opening in the back where the weld is to be made of no less than $\frac{1}{16}$ inch or no more than ⅛ inch and on the front of no more than ½ inch or no less than ⅜ inch. Now tack the patch very good so as to keep it from shifting or getting out of place, using ⅛-inch Norway iron, as this is the best size iron, to use in the firebox or on boiler work. Now fill up 6 to 8 inches, bring it out flush with sheet, then brush the oxide which forms with a good wire brush. Reinforce $\frac{1}{16}$ inch—no more—because many a good weld has been spoiled by using too much metal and having the fire burn it.

I do not believe in welding cracks over 10 inches long, but if you have an engine that has just come in with a crack, say 18 or 20 inches long, it can be welded with good success by welding up the crack flush with the sheet, then get some ¼-inch rods, say ¾-inch long, cut a groove in the sheet, place the rods and weld them in, covering the rods, placed two or three inches apart. In order to crack the weld the rods would have to break.

Welding cracks on the top back flue sheet has been very successful but where there are more than six or seven of these it is best to put in a patch the full length of the flue

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sheet. Cut the patch out so that it will take half of the top row of flue holes and have the ends a good 60 degrees. Weld the bridges in the center first, then reinforce both sides on the inside of boiler. Welding patches in door holes, sleeves and patches outside casing of fireboxes may all be welded in the same manner.

In the case of a broken mudring, cut out the sheet so as to give easy access to the job, then cut the mudring by V'ing it, chip the oxide off with a chipping hammer, then get a piece of boiler plate ¼ inch and put under the open and weld same as broken frame. The piece taken out to get at mudring can then be welded back in place or a new piece in its stead.

Welding Flues in Back Flue Sheets

There are several ways of welding flues in back flue sheets. My way is to bell them, leaving 3/32-inch for superheater pipes; for 2-inch flues ¼ inch, rough the sheet or sand blast it, then get the acetylene torch to burn the oil off the sheet, or, fire the engine up and when she comes in the oil will be off the sheet. With superheater pipes and flues that have made their mileage and not been welded you can make a better weld by cutting off half the old bead and you can get two more shoppings, which is the three-year limit for flues, by welding the flues belled. This is not only welding the flues but building up the worn flue sheet that has been worn by the beading tool riding on the flue sheet. I have two fireboxes welded without a rivet in them except in the mudring.

The front flue sheet can be welded by cutting it out and putting in new sheet welding, both inside and out, in the head of the sheet. In welding star cracks around staybolt holes I have them countersunk, taking all the crack out; then get a piece of copper pipe smaller than the hole and weld all around it, thus saving the drilling of a new hole. Copper takes the place of carbon, the weld will not stick to it, and it will leave a clean, smooth surface.

In welding a blind flue hole I have welded it up solid, but by getting a tapered plug, and welding it in a great deal of material and labor may be saved. In welding in cracked bridges in the flue sheet where the flues are in, V out the crack, weld it up and also weld in the two flues on both sides. In welding up a flue sheet around flue holes, where worn by the beading tool and the flues are not to be welded in, fill up flush with sheet and make the flue holes smaller so that when you ream and face the sheet will be as good as new.—*The Boiler Maker.*

PREPAREDNESS FOR RECONSTRUCTION PROGRAM

This Is the First of a Series of Articles on the Needs of ....Business After the War—Importance of Raw Material....

With a sincere desire to save the nation from future disaster, men are asking one another:

"What is to be the business situation after the war?"

There is still plenty to do before that question will be really urgent. Even so, the elements of victory have entered the struggle on the side of the Allies. It is probable that this period of destruction will end before our nation is organized to meet the problems which peace will bring. Therefore the question as to what business will face in peace times is vital to every man in America.

If we can imagine what is to come, the questions for immediate discussion are:

What can or should be done to simplify and improve conditions?

Shall we have an organized program for reconstruction?

Shall that be under the direction of the Government or some other agency?

If the Government directs the movement, what part shall it play in the period of reconstruction? Shall it substitute itself for business? Shall it be a partner of business? Or, shall it merely act as a referee?

The Complex Problem

The subject is almost inconceivably big. Because we are confronted by competitive conditions at home and international considerations, it is so complex the danger is we will all lose ourselves in generalities and mere theories while discussing it.

That is, if we ask what is to be the business situation after the war, so many phases and possibilities present themselves it is easy to become lost in the maze of speculative and apparently conflicting data and opinion.

Or, if we abandon that field of conjecture and ask what part the Government shall play, we become involved at once in a political dispute which has raged for centuries; we lose the point while debating what is the proper function of the Government.

In either event, the danger is of merely starting an argument where the real need is to begin something constructive.

The obvious duty is to avoid too broad a generalization and to begin that analysis of the present and probable future situation which will lend itself readily to a synthetical treatment of the whole subject. It is going to be necessary—as we see it—to start with two groups of known and admitted facts. These will give us the ground-work of information upon which to build toward a proper line of action.

Four Points of Confusion

The first group of facts embraces:

Commodity prices today are from 100 to 500 per cent above normal; they must in peace times return to normal in obedience to the law of supply and demand.

Labor is commanding an abnormal wage today and is congested, in wholly unnatural fashion, into certain communities; wages must come down and labor be more widely distributed.

Credits of business concerns are out of joint, due to the present abnormal earnings of some companies; the enforced suspension of some whole industries; and because the Government has commandeered the capital of the country for other purposes after the war. The whole credit system will have to be revised and each company given a new rating.

Normal relations between merchant and customer have been destroyed; they must be restored, preferably without an intervening period of unrest and disquiet.

In this group of facts we are not concerning ourselves with any international questions or speculations but with only those things which will confront every business man, namely: What shall I charge? What shall I pay my labor? Where may I borrow money? To whom and on what basis may I sell?

It is obvious that if we allow prices to return to normal by gravity; if we allow labor to distribute itself by the filtration process; if we establish credits by the banking method of studying the proved balance sheet on current business; and if we re-establish market relations by turning loose the forces of unrestrained competition, we have entered upon a period of readjustment which will not end until several years of depressed business have intervened.

That is to say, prices cannot come down by gravity except through a period of stagnation. Wages cannot be brought down to normal by gravity except through a period of unemployment. Credits cannot be re-established—in a way to satisfy the bankers—except by a prolonged study of the relation between the then current earnings and the invested capital in each concern. And, enduring relations between merchant and consumer cannot be firmly established until prices have again found their equilibrium. All of this means unless these readjustments are hastened by organized effort of some sort—a prolonged period of unsettled business with depression as the most likely and natural expression of the times. One thing is obvious. War prices for commodities and labor cannot endure in peace times. War credits, with-

but war profits, are impossible. And, when the governments stop buying, someone else must begin. These things make violent readjustments necessary.

That is the first group of facts with which we have to deal. It calls loudly for some organized effort keyed to avoid this wasteful delay which natural processes would involve. It calls loudly for a preparation-for-reconstruction movement which is as necessary now as was, recently, the preparation-for-war movement.

Getting the Money

The second set of facts is somewhat more complex. Still, it is one which demands immediate attention. It starts with the known fact that, after the war, the Government will need vast sums of money which it cannot consistently raise by the flotation of bonds. Instead, it will have to begin to get, through taxation, money to retire outstanding bonds when they reach maturity.

It may, of course, be necessary to float a small bond issue to pay the enormous expenses of demobilization. That, however, will be part of the war expense and will be legitimate. Otherwise, further Government bond issues will be unpardonable. Thus the outstanding fact is that the Government will need to raise enormous sums of money.

This can only flow to the nation as a small percentage of the earnings of the people who are employed. Thus if the nation needs vast sums, the people must be earning much more. It is begging the question to say that this money can be advanced as an interim loan by the banks. They have a loaning power which is directly proportionate to the amount of business they are doing. The volume of business done by the banks is directly responsive to the activities of the people themselves. So, the revenue of the Government first and last is traced directly back to the lucrative employment of its people.

To get a proper perspective on this subject of the money—the conditions being considered—it is necessary to go back into elementary considerations and center thought upon those things from which all wealth springs. At the start, it is necessary to eliminate from the preliminary discussion whole groups of business activity. By this process we reach the dependable bed rock of admitted fact. That is, we must analyze business until, by a process of elimination, we have found the mainsprings of all business activity. To get such bedrock—as we believe—it is necessary to divide all business roughly into two major groups, namely:

First—and most essential—those industries which have, in themselves, relatively small earning power but which *originate whole lines of business activity.*

Second—Those concerns which, when active, are rich but which *depend for their success on the previous activities in the first-mentioned group.*

For the sake of convenience, we shall call them the "originating industries" and the "dependent industries."

The Originating Industries

In the group of "originating industries" we include those things which spring primarily from the soil. They are admitted—in both an academic sense and in fact—to be the source of all wealth.

First, in this classification is the farmer. His business is not lucrative in itself. Yet what he produces gives rise to long lines of activity—such as the manufactured products due to the working over of cereals, meats and cloth materials—which are producers of great wealth.

Second, there is the producer of iron ore. His business is elemental but his production starts into life a long chain of lucrative activities which culminate in the refinement of the production of finished steel.

Third, there is the producer of coal. The operator's activities are surely elementary. Yet his work yields a product which creates tremendous activity by inspiring commercial energy in one direction and which becomes the raw materials of the chemical industry in another direction.

It is possible to extend this list of originating industries by including the production of lumber, of clay products, of precious and semi-precious metals and of cement. Mere reiteration of details, however, does not increase the importance of the subject. But, out of such a trend of thought comes the one vital truth, that:

Since the source of wealth, primarily, is in the soil products, and since prices and production of raw materials must be adjusted before the makers of finished material can proceed, the first line of attack on any preparedness-for-reconstruction program must be the problem incident to the production of raw materials.

The Dependent Industries

Included in the "dependent industries" are those concerns which of necessity depend for their activity, if any, upon the previous activities of the other group. At the top of the list of the "dependent industries" are the railroads—and other transportation mediums—the banks and the merchandising houses. The railroads obviously cannot carry unless they have something to carry. The merchandising houses cannot sell unless they have something to sell. And, the banks cannot collect and lend money unless someone is first making it. So, these are essentially dependent industries.

Beginning with them as a base, we could, if it were advisable, go through a long list of luxuries and semi-luxuries which properly belong in this "dependent" class. They all trace back to the same root, however; they can do nothing until there is activity in the originating group—the concerns which work in the soil.

The Great Task

With the relationships and interdependencies thus established, we are ready for a discussion of what is the proper starting point for concerted action to simplify future business.

It must be realized that we Americans have a task before us which is almost as difficult, as it would be to start from the beginning to build something new. Indeed the more highly organized world has a harder job than has Russia. The organized business world must first tear down an established but abnormal order of things and then build something out of the fragments. On the contrary, Russia has merely to begin at practical zero and, by the employment of energy only, build a system of action on her admitted abundance of raw material. The organized world therefore has the harder work to do because it must first tear down and then build up.

Importance of Raw Material

It goes without saying that raw material is essential to any reconstruction period. Indeed the success of any constructive effort rests first and solely upon an available supply of raw material. That is so elementary it needs no further comment.

But, there is another factor in the present situation which is of first importance. That is that the world will emerge from this war with the old ship owners in about the same relative positions to each other that they occupied before. Great Britain has suffered serious losses of tonnage through the submarine but she is regaining. And, the new tonnage will be better than the old. France has a definite inspiration to build ships and docks and is improving its opportunity. The Scandinavian countries may be expected to hold their own. It is even conceivable that Germany may now, at some hidden spot, be replacing the tonnage which she lost through seizure and destruction during this war.

The gripping fact is that two new ship builders have been added to the international list—America and Japan.

With momentum so strong in that direction, it is hardly likely that ship building will come to a sudden stop at the end of the war. It is reasonable to suppose that ship yards which have been developed—and financed—to the point of highest efficiency will make a desperate fight to continue active. They will try to—and must succeed in part—expand the world's carrying capacity. And, those who control the ships may be relied upon to try every expedient to keep their tonnage employed on some kind of a basis.

This—to our way of thinking—means that we are likely to have more ships than things to carry at once. This presents a problem which must be considered seriously. We will, in the reconstruction period, have to consider the vastly different position which shipping will then occupy from that which it now occupies.

That is to say, today there is a shortage of ships. To make the few ships go as far as possible, they are employed only in carrying the finished material. Speaking of steel, for example, these ships are carrying the finished steel instead of trying to carry the seven tons of raw material which go to make a ton of finished steel.

After the war, the problem will probably be to keep the ships employed. The means to this end, which will naturally suggest itself, will be *to employ the ships to carry the seven tons of raw material rather than the one ton of finished product.*

Raw Materials Glorified

Thus the necessities of the world shipping situation will suggest that the predominance of international trade will be in the raw materials.

This will be consonant with the needs of the world powers which will want, primarily, raw material as the basis of their own reconstruction efforts. *Thus everything points to the super-importance of the "originating industries" or the raw materials in the reconstruction period which is to follow the war.* These therefore must demand first attention at the hands of those who are to supervise the reconstruction efforts of our nation.

Besides, there is a philosophical point in support of this theory. It was the development of the raw materials of America which gave us our activity from the Civil War until the turn of the century. It will, probably, be the development of the raw material which will give the new life to Russia. The possession of raw material—or of the countries which can produce them—will be the big question at the peace table. Everything, therefore, indicates the superimportance of raw material and the need to consider that question as the pivotal point of any preparedness-for-reconstruction program.

Relative Values

As hinting, perhaps, at the direction which action must take ultimately, we will have to consider—early in the discussion of a proper preparedness-for-reconstruction program—the proper and established relations between the prices of raw material—*including labor*—and the proper value of the finished product.

In coal, for example, it is the established rule that the labor cost is eighty per cent of the total production cost. If it should be decided, therefore, that coal should not cost more than $1 a ton to produce it, then the wages of labor should not be more than eighty cents a ton. And, since skilled labor takes two-thirds of this cost and unskilled labor the other third, the indicated price for each is clearly established. (These, incidentally, are mere figures and not suggestions.) Then, the cost of coal having been established, the cost of sales and administration must be added, plus the margin—if any—of profit. These percentages are all known and can be figured.

Having established a basic price for one commodity, the basis for other prices is automatically established. That is, it requires five and a half tons of coal to make a ton of steel. The price of coal and the price of other raw materials having been determined as indicated, the proper *initial* and *maximum* price for steel, *in a reconstruction* period, is easily figured. In fact it becomes a simple problem in addition.

Arriving at Opening Prices

That is, it is not really necessary to allow prices to gravitate to normal through a distressing period of depression and the slow process of reconstruction which will take years. Instead it is easily possible, through as indicated the application of known percentages, to arrive at opening—and maximum—prices for the period of reconstruction. This can be done by a system of calculations with agreed raw material prices as the base.

These things all fall, logically and naturally, out of any analysis which first takes into account the word situation and opposes it by the clearly proved world need. Also, these things fall naturally out of the consideration of the difficulties which must confront each individual in America. If we have analyzed the situation correctly, then the call is for some kind of concerted action along these lines.

The question instantly arises, of course, what form should that action take? That is a moot subject. We do not care, at this juncture, to go extensively into that question. We will content ourselves here with the statement that we propose to analyze and discuss that subject at another and proper time.

Out of this whole discussion comes one fact of vital importance. **There are serious basic questions** to consider the return of commodity prices to normal; the restoration of labor cost to normal; the reestablishment of commercial credits; and, the revamping of market relations—before we can even begin to reconstruct. This must be done carefully and quickly or the world must suffer a business relapse while normal conditions are being restored through the gravitation process. *Therefore, if we are not to suffer the inconveniences and annoyances of a readjustment by gravity, we must have a preparedness-for-reconstruction movement. That seems to be the most urgent need of the hour.*

CITY SCHOOLS ADVERTISING COURSES IN OXY-ACETYLENE WELDING AND CUTTING.

Mr. F. W. Christy, Director of Industrial Arts in the Cincinnati Public Schools, is making an active campaign to increase the attendance at the evening classes in Oxy-Acetylene Welding and Cutting. "It is the best chance," Mr. Christy recently said, "that I know of today for young men to learn a most useful occupation. There is a demand for this class of mechanics in the army alone that is impossible to fill. The operation of the torch in simple work is not very difficult and I believe the average student in our manual training courses could be trained to do the commoner grades of commercial work in about eight weeks.

"Besides being learned within a reasonably short time, oxy-acetylene welding is one of the best paying trades. Trained operators are constantly in demand. Those who wish to apply for enrollment will be aided in commencing the course without delay.

ARE WE A TRADE?

Elsewhere in this issue we publish an article written by Mr. Nels Johnston, who feels that Mr. McAdoo ought to recognize welding as a trade. We think welding is more than a trade, as the term is usually applied. The good welder is usually a man of parts—he knows much about several trades. Oftentimes he is a graduate of a recognized trade. If it were possible to classify welders, separate them according to their recognized ability, we believe "Master Welders" should outrank even the Blacksmiths of King Solomon. Therefore we urge you to read what Mr. Johnson has to say.

Who's Who

CAPTAIN FRANK C. HASSE

Captain Frank C. Hasse is well known in the welding trade on account of his former connection with the Oxweld Railroad Service Co. For years he traveled all over this country teaching the young idea how to shoot. He has made an exhaustive study of the art of welding, particularly as adapted to railroad work. In 1913 he entered the service later being made District Superintendent. He is now in the Quartermaster Corps of the Army, helping to train the vast number of welders who are needed to keep Uncle Sam's equipment in order.

Captain Frank C. Hasse

OXY-ACETYLENE AND ELECTRIC WELDING*

By A. F. Dyer

In boiler work, most of the welding is done with the iron electrode. Using a mild steel or Swedish iron as a filler, it is found that the electric process localizes the heat more so than the gas, though it is the writer's humble opinion that the gas makes a closer and neater weld, as all welds made by the electrode are more or less porous unless hammered up. It pays better whenever possible to do so to put in quarter or half sides in order to get out of the fire line in preference to putting in a patch, for, as a rule, however well the patch is welded it generally gives out in from twelve to eighteen months' sevice, and the same applies to cracks, whereas the half or quarter side should last as long as the firebox.

When a nest of small cracks is found round the staybolts, the bolts are removed and the holes countersunk and welded up. This method has been found to be very successful.

For cutting steel and wrought iron the oxy-acetylene process has practically no competitor, it being impossible with the carbon point to cut as fast or as fine and neatly as the gas torch, although for scrapping fire boxes and frames the carbon point is cheaper if time is no object and labor cheap.

No roundhouse should be without an oxy-acetylene outfit, both for repair work and as a part of the wrecking outfit. Many days are lost by engines being tied up through parts having to be sent to the nearest big shops for repair which could be repaired on the spot with a welding and cutting outfit. All large roundhouses should have both processes, as they would pay for themselves over and over again.

There are many different opinions as to which is the best process. No shop is complete unless it has both equipments, although the gas has really the widest range; but, on the other hand, a heavy piece of steel or iron needs no preheating with the electrode, but welding can be commenced as soon as your arc is drawn; 95 per cent of the failures which occur, instead of being laid on the process, should be placed on the shoulders of the operators.

Welding should not be treated as a side line of the machinists' or boiler makers' business, but should be treated as a trade in itself, as it really is, for it needs the entire concentration of a man's mind, careful study, plenty of practice and a conscientious man to make a welder.

Wherever possible, a separate building or suitable space should be provided for bench work and should be equipped with a suitable furnace for heating and annealing castings, and also plenty of floor room to allow of charcoal fires being built for preheating cast iron jobs for welding.

An unusually interesting discussion followed the reading of Mr. Dyer's paper, in the course of which Mr. Barry, of the Oxy-Acetylene Company, said that the company's work came from all over the country—from the smaller roads, such as lumber roads and contractors' outfits, and the like. They ran up against anything and everything, and it is interesting to see what they have accomplished when it comes to acetylene and electric welding. If you wish, you can weld fireboxes complete with either the acetylene or electric welding. It is quite immaterial which process you use, and, of course, the acetylene operator will claim that his process is the best, but he does not know anything about electric welding. Both processes have their advantages, and you can use both. In using the oxy-acetylene process on fireboxes we have tried the butt weld and the result looks fine, but on account of the chance of the operator being careless the lap weld is best. I beg to differ from Mr. Dyer, as by putting a lap weld in fireboxes, especially in the corners, you can reinforce as heavily as you like, and we have found more success with the lap weld than with the butt weld, but there is no doubt that in welding side sheets to crown sheets or in the corners of fireboxes, either the butt or lap weld can be used—it depends upon the operator. The same thing applies to steel tank work.

* From paper on "Oxy-Acetylene and Electric Welding and Cutting Processes in Locomotive Works," read at recent meeting of the Canadian Railway Club, Montreal, Canada.

FUSION WELDING FALLACIES*

By S. W. Miller

Within the past two decades, fusion welding processes have been developed until they are now used both in the manufacture of articles, the parts of which would otherwise be riveted or joined by other means, and in repair work. In both fields, they have proved of exceptional value, and in many cases have revolutionized past manufacturing methods and made it possible to place on the market cheaper and better articles than was possible by the processes displaced; but fusion welding processes are not simple, and many fallacious ideas concerning them are prevalent. The more important of these will be treated in this series of articles; those that will be treated in the present installment are as follows: The belief that a reinforced weld is stronger than a weld of the same thickness as the sheet; that reinforcing a weld is as good as welding through a piece; that high tensile strength in a weld is of great importance; that wrought iron is the best welding

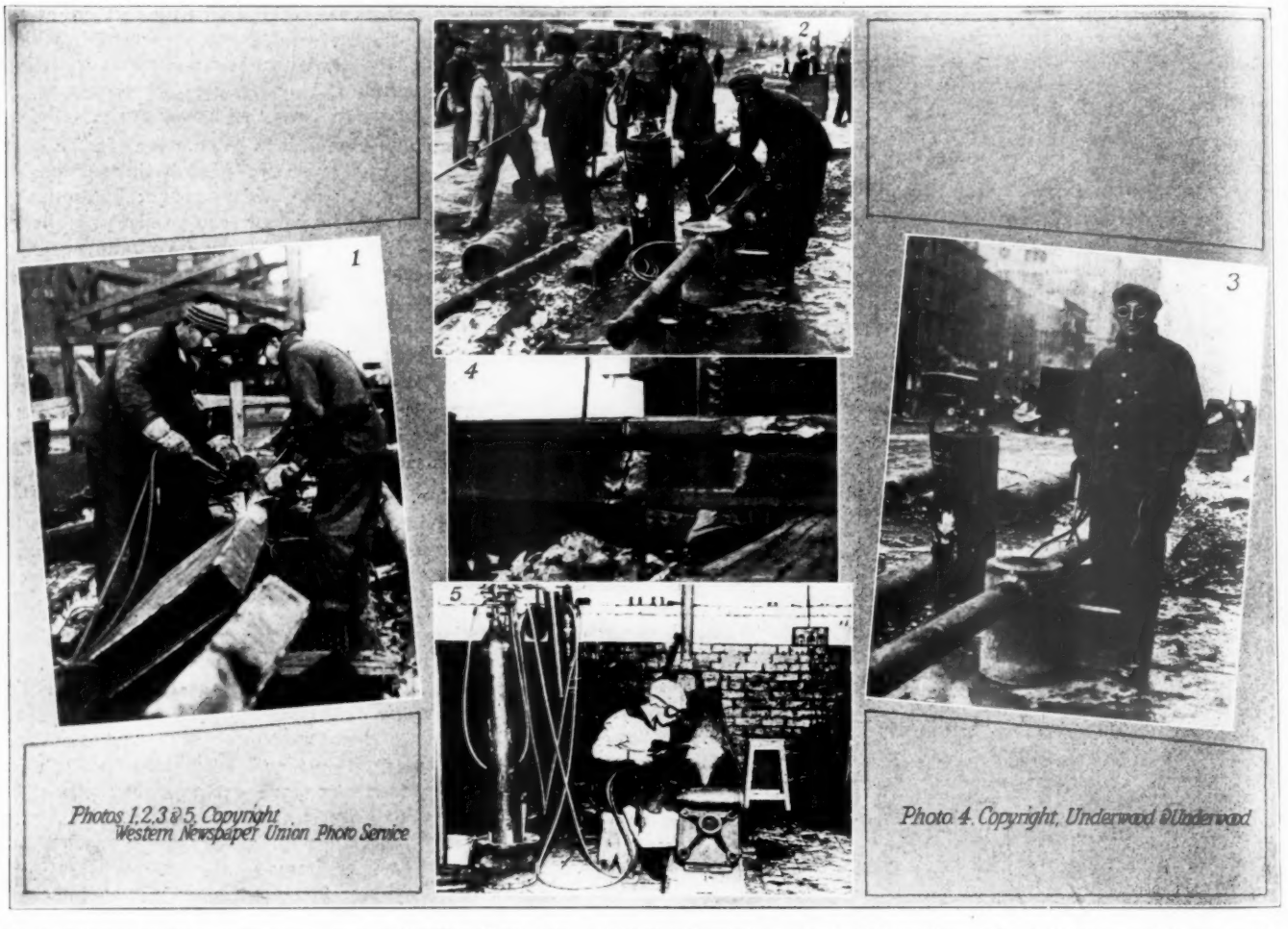

Fig. 1. Subway work in New York. Fig. 2. Welding Pipe. Fig. 3. Welding Conduits. Fig. 4. Rail cutting. Fig. 5. Woman welder on aerial bombs.

junction of the thick and thin parts, which is likely to result material; that any wire is good enough for the added material; and that the addition of small quantities of metal at a time is good practice.

Reinforcing Does Not Necessarily Strengthen a Weld

Frequently a welder is advised to reinforce a weld; that is, to increase the thickness of the piece at and in the vicinity of the weld, on the theory that the greater the amount of metal, the stronger is the piece; but this is not always true. Particularly is it not true when plates are welded from one side, as in the case of tanks, etc.; in fact, reinforcing then weakens the structure. This weakness is due to two conditions: First, the thickening of the weld concentrates the stresses at the

Extracts from a series of articles written by Mr. Miller for machinery.

in a detail fracture, even in uniform material; this is the same as having sharp corners in shafts, which frequently break from this cause. Second, the center lines of the reinforced weld and the sheet are not the same; therefore, a bending stress is introduced in addition to the tensile stress. This condition is called "eccentric loading," and the maximum fiber stress on the section may then be found by the formula:

$$S = p\left(1 + \frac{6E}{A}\right)$$

in which S = maximum fiber stress in section;

p = mean fiber stress in section, or $\frac{P}{A}$;

E = eccentricity or distance from center of section;

A = width of section;

P = total pressure on any section of a bearing of uniform thickness.

Assuming that the sheets are straight and that the piece is subjected to an average stress p of 12,000 pounds per square inch, based on the thickness of the weld, P will be 6,000 pounds; as shown, E is 1/16 inch, and A, 0.5 inch. Then, by the formula, the maximum fiber stress will be:

$$S = 12{,}000 \times \left(1 + \frac{6 \times 1/16}{0.5}\right) = 12{,}000 \times 1\tfrac{3}{4} = 21{,}000 \text{ pounds}$$

or 1¾ times the average stress over the section of the weld. But, based on the thickness of the sheet, the piece would be subjected to a stress p of 15,000 pounds per square inch. Then P will be 7,500 pounds; E is 1/16 inch; and A, 0.5 inch. Then the maximum fiber stress will be:

$$S = 15{,}000 \times \left(1 + \frac{6 \times 1/16}{0.5}\right) = 15{,}000 \times 1\tfrac{3}{4} = 26{,}250 \text{ pounds}$$

In each case the maximum fiber stress will be too great for safety. This difference between the maximum and minimum stresses on opposite sides of the sheet causes the plate to bend toward the bottom of the vee, and, in the course of time, is very likely to result in fracture. The time necessary for this to occur may be short or long, depending on the eccentricity of the load and on the amount of the stress. Especial attention is called to the fact that a comparatively small eccentricity produces enormous fiber stresses, and it is possible for these stresses to be so great that the piece will break the first time the load is applied. Any results obtained from tensile test pieces made with reinforced welds are erroneous and misleading. All published tests the writer recalls were made on test pieces that were not machined, which doubtless contributed largely to the discordant results obtained. There are no published results of weld tests that are consistent, as far as the writer knows.

Somewhat along the same line is the statement that reinforcing a weld is equivalent to welding through the piece, which was made to the writer some time ago by the foreman of welders in an important tank shop. It is evident that where the weld is not made entirely through the vee, the eccentricity and the fiber stress are greatly increased, thus weakening the structure.

High Tensile Strength in a Weld Is Seldom of Great Importance

Most welders, in speaking of the quality of their welds, lay great stress on the tensile strength. As a matter of fact, high tensile strength is of much less importance than other characteristics. No important engineering structure that the writer can think of at the present moment is subjected, in any of its parts, to an unvarying tensile stress. The stress always varies from zero, or some amount, to a maximum, or from a maximum in one direction to a maximum in the other; in addition, these changes are usually accompanied by shock. To provide for these variations from a steady stress, it is customary to lower the permissible fiber stress, especially in the last case. For instance, a boiler or pressure vessel is never free from changes in pressure, and so the proper reduction in stress must be made.

A weld is nothing more than a casting that has not been heat-treated; and while it has enough tensile strength, it is brittle and has low resistance to shock, vibration, and changes in stress. It is far more important to produce a weld without these bad qualities than to strive for high tensile strength, as the strength is always sufficient if the weld is no thicker than the sheet. In fact, an unannealed weld resembles, in ductility, a piece of cast iron. This is very noticeable in pulling tests weld in a tensile testing machine, as, when not annealed, it is difficult to get their elastic limit, it being frequently so close to the ultimate strength that the piece breaks before it is really certain that the drop of the beam has occurred. It is, therefore, evident that physical properties heretofore generally neglected must be obtained in welds even at the sacrifice of some tensile strength.

Wrought Iron Is Not Necessarily the Best Welding Material

The statement is commonly made that wrought-iron wire is the best material for welding steel; in fact, in 1915, the writer made the following statement: "It is generally claimed that wrought-iron wire is the best for this purpose and that the imported wire is better than the domestic. . . . It is, however, somewhat of a question whether material with a small percentage of carbon, say, 0.1 per cent or, perhaps, as low as 0.05 per cent, would not give just as good results, provided the impurities, such as sulphur and phosphorus, were kept to as low a point as is the case in wrought iron. There are other matters in connection with this subject that have never been investigated, as far as the author knows, and inasmuch as their investigation requires great accuracy and considerable time and expense, the lack of information is not to be wondered at. It is a fact, however, that the use of any pure iron wire gives good results and, until the matter is more carefully investigated, one is safe in using that material." Wrought iron of the purest kinds was probably the best material available at one time, and it was much better several years ago than it is now. Also, as the demand for welding wire was small, it did not pay to make special materials for this purpose. However, wrought iron made by the pudding process contains slag which is likely to get mixed in the weld and weaken it. There is no use in putting into a weld foreign matter that must at once be removed, but which can be done only with considerable trouble on the part of the welder. Low-carbon steel wire is free from slag, and is, therefore, superior to a product that contains it. Still, care must be taken to get wire quite free from sulphur and phosphorus, either of which may cause trouble in the weld; and as ordinary wire is likely to contain these in quantity, it should be avoided.

Adding Small Quantities of Metal At a Time Is Not Good Practice

A steel casting manufacturer does not pour his molds from a number of small ladles, but uses one large enough to pour the entire casting at one time. He also keeps the metal fluid, so that dirt and impurities can get to the risers, producing a clean casting. Making a weld in steel is the same as making a steel casting. Following the analogy, the more metal that can be kept in a molten condition at a time in a weld, the cleaner it will be. Adding small quantities tends to produce laps and cold-shuts and to include impurities in the weld. A clean weld is the foundation of successful welding; therefore, the addition of small quantities of wire at a time should be avoided.

Among other common fallacies are the ideas that a weld that is not heat-treated is suitable for any engineering structure, no matter how important; that any thermal disturbance or change in structure in or near a weld is negligible or easily corrected; that the structure of a weld can be made as good as that of the original material; that the materials used at present are entirely suitable; that a welded piece is equal to a forged piece; that welding problems can be solved by hit-or-miss methods; and that an electric weld is superior to an oxy-actylene weld.

Non-Heat-Treated Welds Are Not Suitable For All Engineering Structures

It is a common belief that a weld that is not heat-treated is suitable for any engineering structure no matter how important. The writer's tests and experience, however, indicate that if successful and safe results are desired it is absolutely necessary to heat-treat both the weld and all metal in its vicinity. In the case of small pieces, this can be done in a crude, but effective, way with the welding torches; but for larger pieces, special furnaces or other apparatus is needed.

Where low-carbon welding wire is used to weld ordinary soft steel, there may be a difference in the temperatures required for the weld and original material of 300 degrees F., as a steel casting requires a higher refining temperature than forged steel of the same carbon content. This means a double heat-treatment; a high temperature to refine the weld, and a lower one to refine the coarsened original. The double treatment should be avoided, if possible, on account of the cost, so the welding material should have such proportions of carbon and other necessary elements as will produce a clean, sound, deoxidized weld; the material, when cast into the weld, should require the same refining temperature as the material welded, and in the refined condition, it should have the proper physical characteristics as given in the first installment of this article.

* * * *

Thermal Changes in Structure Are Not Negligible Nor Easily Corrected

The belief that thermal disturbances or changes in structure in or near the weld are negligible or, if not, are easily cor-

rected, is wrong. The heat of any welding process changes the structure of the original material greatly; this change extends farther from the weld in the case of oxy-acteylene welding than in the case of electric welding, and the grain growth is greater, but the zones of changed material are not so distinct. As the writer believes in properly heat-treating all welds, he does not think there is much difference in this respect between the two welding methods. There are, though, other important structural difference. The exact influence of these is not known nor, as far as the writer knows, have they been studied very much; in fact, even their nature has not been fully determined.

The coarsening of the grain reduces the ductility and resistance to shock of the metal. These conditions cannot be entirely overcome by heat-treatment, but a very great improvement can be made. Successful heat-treatment of the work requiries a knowledge of the critical points of the steels used, and these points depend mostly on the carbon content. Besides, for accurate work, the proper temperatures for the proper time and the proper rates of cooling must be carefully maintained. It is not hard to get accurate results with small pieces in a small furnace, but in the case of large pieces the variations in furnace temperatures, the inaccuracies of pyrometers, and other variables materially affect the results. Still, as it is now possible to use heat-treatment methods in ways believed impossible a few years ago, the writer sees no reason why such work could not be carried out on large pieces, tanks for example, even when viewed from a commercial standpoint. At first a factor of 50 per cent, for instance, of the plate strength might be all that would be safe, but certainly the welding industry would not be satisfied with that result and, as in all similar cases, improvement would be certain.

The Structure of a Weld Cannot Be Made as Good as That of the Original Material

It is commonly stated that the structure of a weld can be made as good as that of the original material. This, however, cannot be done, for the finest grain, and therefore the best physical qualities, can only be obtained by using both heat-treatment and forging, or other mechanical treatment. As forging cannot be done in most welds it is evident that the best results cannot be secured. The most that can be expected is what can be obtained in a properly heat-treated steel casting, and this is not equal to a heat-treated forging.

Material Now Used Is Not Entirely Suitable

Contrary to the general belief, all material now used for welding is not entirely suitable. Much of it is likely to carry impurities into the weld so that good results can be obtained only when great care is used. However, suitable materials for all purposes will, no doubt, eventually be found.

A Welded Piece Is Not Equal to a Forged Piece

A customer frequently asks if a piece of forged steel will be as good after it has been welded as it was before; and he is assured by the welder that it will be. While the welder may be honest in his belief, the piece will not be as good, for a weld is a steel casting and therefore must be inferior to a forged piece even though it is heat-treated. A weld in alloy steel is even poorer and less satisfactory than one in straight carbon steel.

Welding Problems Cannot Be Solved by Hit-or-Miss Methods

The writer has many times stated his belief that, because of the tremendous commercial development of the welding industry, the scientific problems involved have not received the attention they deserve and require. Steel manufacture is carried out under the guidance of chemical and physical laboratories; if this had not been so the great improvement during recent years in the quality of steel would have been impossible. Making a good weld is nothing but making a good casting, and it should therefore be controlled by the laboratory. For this reason, welding problems cannot be solved by a hit-or-miss method of trial and error. This matter is purely a metallurgical one, although there are many practical problems that must be solved in the shop. The basis of all welding is the production of a sound weld of desirable physical qualities.

An Electric Weld Is Not Superior to an Oxy-acetylene Weld

Although the writer does not think that an electric weld is superior in quality to an oxy-acetylene weld, he willingly admits that in many cases electric arc welding may preferably be used. Neither does he think that it is impossible to improve the quality of the welds, for he knows that it is. Electric welding has four disadvantages: It is impossible to see clearly what is going on during the operation; all material in the pencil must go into the weld; it is impossible to go back over the weld to correct any imperfections that may exist; there is an enormous amount of oxide in this weld. The first of these disadvantages is probably insurmountable, if due regard is given to the safety of the operator's eyes; but scientific study may overcome it to some extent. The second disadvantage may be overcome by the production of a specially clean wire. The third is a very unsatisfactory condition and probably cannot be entirely overcome, although skillful operation tends to eliminate imperfections. The fourth may be overcome by the use of a welding wire of such composition as will eliminate the oxide.

The writer, personally, has never seen a perfectly sound electric weld, and he knows electric welds can be improved because some are better than others. As a matter of fact, both oxy-acetylene and electric welding practices need careful revision if they are to have the confidence of responsible engineers. The unanimous opinion of engineers is that in the present state of the art, while some good welds are made, there is such a serious lack of uniformity in the quality of the work as to throw suspicion on all welding. They, therefore, refuse to use it, for example, in boiler construction, where theoretically its uses would be of great benefit. These improvements will have to be made with the greatest rapidity possible, and work incompatible with the fundamental principles of metallurgy must not be done. No welding operation must be performed unless there is an absolute assurance of safety in the result, where life is involved. It will not do to say that because the percentage of accidents that have occurred is very small, and smaller than occurs with other methods of joining, the present methods of welding are good enough. Such an argument was used in connection with industrial injuries; but the safety-first campaign has proved that accidents which were at one time considered unavoidable can be prevented if proper means are taken. It has also proved that the adoption of such preventive measures has more than paid all the expense connected with their introduction. In the same way the adoption of the best possible welding methods and the restriction of such methods to proper applications will result in a great increase in the amount of welding, and in the long run will be much less expensive than following the present methods.

Several commonly accepted but erroneous opinions about fusion welding were dealt with. Among other common fallacies are the following: That a V with an angle less than 90 degrees may be safely and economically used; that low-carbon steel can be burnt with a neutral flame; that a ripple weld is a good weld; that a narrow weld is a good weld; that those in authority can leave to the judgment of subordinates matters involving the possibility of danger to life or property, or requiring scientific knowledge.

A V Should Not Have a Smaller Angle Than 90 Degrees

Although it has been repeatedly stated that a 90-degree V between the pieces welded is necessary, if good results are to be secured, some welders use a V with a smaller angle. As a result, defective welds, due to this cause, are common. It is impossible to make a sound weld unless the angle is close to

(Continued on Page 42)

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L. B. MACKENZIE

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VOLUME 3. SEPTEMBER, 1918. NUMBER 9.

Big Guns and Small.

WHEN we declared war against Germany, the military authorities of Great Britain and France offered to provide our expeditionary forces with big guns in order to save our ship tonnage from the burden of transporting heavy ordnance and to keep at a maximum production the ordnance works abroad.

France and Great Britain had an adequate force of skilled workmen for making heavy ordnance and we had not. In this country all the factories that could make the large machine tools necessary for turning, boring and pressing big guns were already busy on contracts for the Allies. In order to prevent a confusion in allied plans, to save ship tonnage, and to make a wise use of such arsenals and workmen as the Allies had, our war department agreed to accept as much as possible of its first year's supply of guns abroad and to devote that year to developing its own big gun industry.

The program has been carried out successfully. Our forces in Europe have had a sufficient supply of guns and ammunition purchased in Europe. Our men in the trenches have had the same heavy ordnance protection that the French and British troops have had. We have sent over some heavy artillery, to supplement the allied supply. And we have developed our own design, built our own factories, installed our machines and trained our own workmen for the manufacture of all sorts of big guns.

We have spent five billion dollars on ordnance in our first year. We are planning to spend twelve billion dollars in our second.

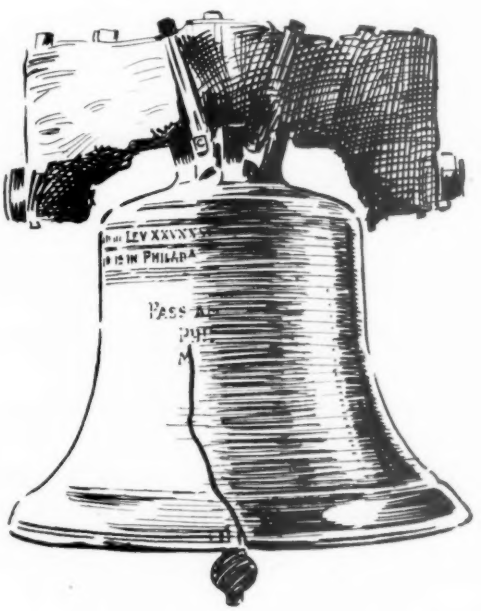
The complaint has been made that our ordnance bureau lost six months in vain efforts to improve on the perfect recoil mechanism of the famous French 75's. That is untrue. The charge is due apparently to the fact that we prepared designs for an American six-inch gun which was put into production before the models for the 75 arrived from France. We are making both guns, and our contracts call for the delivery of more than 3,000 of them by January, 1919. After that date the 1917 model of the French 75 will be manufactured here at the rate of about 500 a month. And our own new gun, with the "split" carriage, is more flexible even than the French 75, and more deadly therefore to the enemy.

Of the six-inch sea coast gun, our contracts provide for the delivery of 400 by January, 1919, and of 200 a month thereafter. Of the 155 millimeter howitzer, 1,500 are to be delivered by January, 1919. Deliveries of the 240 millimeter howitzer are reaching 100 a month.

We have produced, in the light and heavy Brownings, the best guns in the world, and we are making them at the rate of about 5,000 a week. The new American rifle is admittedly an improvement on any of the Allies' rifles and far superior to the enemy's. We are turning them out at the rate of 60,000 a week. Our automatic pistol, caliber 45, has defeated the Germans in close fighting. All these weapons are being produced in vast quantities, and our ordnance division, that was cartooned and scoffed at as the joke and failure of the war, has proved itself as resourceful as the men whom it has armed and as efficient as the weapons with which it has armed them.

Liberty Bell

LIBERTY BELL rung when the Continental Congress declared the independence of the United States, on Monday, the 8th of July, 1776. It bears the inscription, "Proclaim liberty throughout the land and to all the inhabitants thereof." The order for the bell was placed in 1851 and when it arrived in 1852, in apparent good order, it was cracked by a stroke of the clapper while being tested. So the original bell was recast by American workmen, and in 1853 it was placed in service. For 50 years the old bell continued to be rung on every festival and anniversary, until it eventually cracked. An unsuccessful attempt was made to



repair it and since that time the old bell has remained silent.

Some of these days, and not too far distant we hope, there is to be another day upon which liberty will be proclaimed throughout not only this land, but all other lands and seas as well. What a fine thing it would be to tune

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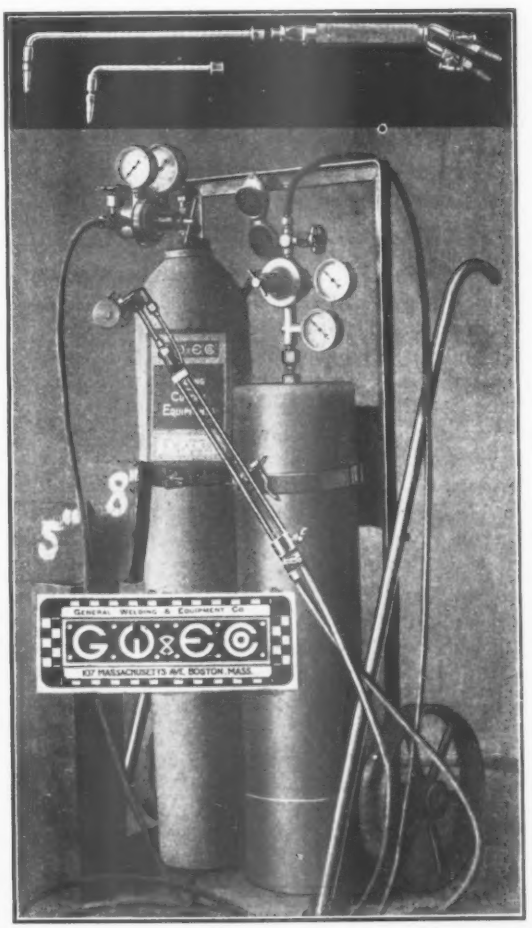

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AS TO DESCRIPTIONS SEE OUR FORMER ADS

up the old Liberty Bell and have her all ready to ring out the submission of the Hun.

Every experienced welder knows that it's a very easy matter to weld a crack in a bell, big or small. It is also possible to restore the original tone if desired. There is no guess work about the task. What could not be done in 1861 can be done very easily now.

A diagram of Liberty Bell, showing the crack is shown herewith.

What do you welders think about the feasibility of welding the old bell? Don't you think it would be an honor to the trade to give back to the Nation and the world the voice of the original herald of Liberty?

If we had about a thousand expressions of opinions we might send them to Washington. Perhaps we might be authorized to create a board of experts to undertake the greatest welding job of all times. L. B. Mackenzie.

The Welder's Debt to France.

IN addition to standing guard over the Hun the French have done something for American welders. From France has come a good part of what we know about welding, and it would be fitting indeed, if American welders could do something for French welders.

A friend of *The Welding Engineer*, Mr. C. J. Nyquist, writes us as follows:

"Mrs. J. Linden Smith, representing the Franco-American Committee for the care of children from the Front, writes in the New York Times, as follows:

"'The number of children needing assistance, a number constantly on the increase, has now reached the stupendous total of 600,000. Of these the French government is caring for about 400,000. The rest of the work must be done by Americans.

"'France is dotted with a multitude of homes in which the mother, with the head of the family at the Front, perhaps dead, is struggling to care for her children and to keep the wolf from the door. These mothers toil early and late. Some of them have little patches of ground which they make shift to cultivate. Poverty lurks side by side with them constantly. They try to keep the family together—to keep the children with them. Only under dire necessity will they consent to part with them.'

"The members of the oxy-acetylene industry in this country, whether welders, apparatus mechanics, manufacturers or supply dealers, certainly are under much obligation to France, where the process originated and where the most important developments of this process have been made.

"I believe it would be a handsome thing for us to do to get together and help to make the coming Christmas a happier one for some of those unfortunate children, many of whom, no doubt, are the children of French welders. Permit me to suggest, Mr. Editor, that you publish an appeal to our welders, and others benefited by our industry, for Christmas subscriptions. If necessary, let us organize a Relief Committee, and put the matter up to every individual that can be reached to give every assistance, whether large or small, and I am sure that we will be able to bring a great deal of Christmas joy into many of those struggling homes.

"Mr. P. Rosemberg, one of the Directors of de l'Office Central de l'Acetylene, Paris, is well familiar with the situation and would, I am sure, gladly take care of the distribution of our gifts."

"C. J. NYQUIST."

It would be a fine thing to send a Christmas gift to the children of French welders. The money could be collected and forwarded to Mr. P. Rosemberg, to be used to the best advantage, and we are sure many a little heart will bless the men of this country who remembered them at such a time.

There is no time to be wasted. Contributions, no matter how small, should be made at once. The Editor of *The Welding Engineer* will accept them and will transmit the receipts to our friend Rosemberg. No matter how small your gift—remember it's for small folks—the little fellows whose fathers made it possible for our boys to be there in time. Send a dime or a dollar—it's receipt will be acknowledged in these columns. Send remittances to L. B. Mackenzie, care *The Welding Engineer*, 608 S. Dearborn Street, Chicago, Illinois.

PORTABLE ARC WELDING MACHINE

A new type of portable arc welding machine that is gasoline driven has been brought out by the Lincoln Electric Co., Cleveland. The welder is designed for use in shipbuilding and ship repair work for oil pipe line work, for general commercial work or in any place where electrical current is not available. The machine is mounted on a skid for convenience in moving around, and can be placed on a motor truck, shop truck or other vehicle for transfer from one location to another.

The complete welding unit consists of a Winton gasoline engine, a standard Lincoln motor, generator, an arc stabilizer and a control panel. The photograph shows the arrangement of the machine, the radiator being at one end and the gasoline tank directly above the engine. The engine is started by a crank in front of the radiator. The control panel on which knife switches are located is placed above the motor.

The engine motor and generator are direct connected. This is a variable voltage machine, its voltage ranging from 20 volts no load to 50 volts with load, and it provides 150 amp. welding current. The stabilizer is a highly inductive low-resistance coil connected to the welding circuit. This serves to correct momentary fluctuations in the current. The welder itself is virtually similar to the standard Lincoln arc welder designed for general use where electrical current is available.

AUTOMOBILE GEARS.

O. C. D.: Relative to your inquiry regarding the welding of automobile gears we would advise you to use a mild steel welding rod. Most gear welding failures are caused by adding the metal before the material is in fusion, result being that the added metal pulls away from the gear. We would suggest that you keep the parts you are welding in the fire while welding. So far as the adding of sleet is concerned, we see no reason why the added sections should not wear as well as the factor output. Sometimes there is a considerable difference in the mechanical properties of the metals used when manufactured, but I would not care to express an opinion on this subject.

Relative to hardening would say that there are several methods, with some of which you are no doubt familiar. A method which is not usually employed, but which is successful is to heat the section to be hardened to a bright red, almost a melting point, and then play the welding flame with a carbonizing cone over the surface. The excess of acetylene in the flame which is rich in carbon will harden the metal to a sufficient depth.

Relative to the use of "V" blocks. Many large shops do not use them, but depend upon a straight edge to secure alignment. Editor.

The General Welding & Equipment Co., 107 Mass. Ave., Boston, Mass., have issued a new catalog relating to welding and cutting equipment. The new booklet is handsomely illustrated and will be sent upon request.

Generate Your Own Acetylene!

Save Money, Delays, Inconvenience, Shipping Troubles!

It is always a big economy to produce your own acetylene gas with a good generator. In the present abnormal times, when it is almost impossible to obtain this gas in any other way, the generator is an absolute necessity in every shop.

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—produces acetylene gas at from ⅓ to ½ of the cost of acetylene in drums. It will do away with the expense and inconvenience of trying to keep a supply of gas by other means. It will save you shipping troubles and expense. It will eliminate delays—which now cause great losses in welding shops.

Smith's Automatic Acetylene Generator will supply approximately 140 cubic feet of acetylene at each charging. A carbide locking device enables you to move the generator on a small truck about the shop while filled with carbide.

The pressure at which the feed on the generator shuts off is easily regulated by a set screw. The machine can be made to run at a range of from 3 to 10 or 12 pounds pressure. For a low pressure torch like the Smith's Pistol Grip, it is set at 5 pounds, thus affording greatest gas economy. For all high pressure torches it can be set to deliver 10 or 12 pounds pressure. To regulate the machine for light or heavy work the speed of the motor is increased or decreased by a thumb screw.

Provides Constant, Certain Supply of Gas

For most welding shops this generator will meet every acetylene gas requirement. Where an unusually large volume of gas is required it is practical to set up two or more of these generators in batteries and supply any quantity of gas.

Guaranteed The material and workmanship in this generator are guaranteed for a period of one year. It is made of rust-proof metal thruout and will not rust. It uses 1¼"x⅜" carbide. The shipping weight is approximately 350 pounds. Price, $150.00.

Write for Catalog

SMITH'S INVENTIONS, Inc., Dept. 1, Minneapolis, Minn.

Manufacturers of Smith's Pistol Grip Welding Torch

Fusion Welding Fallacies

(Continued from Page 36)

90 degrees, because of the high surface tension of the melted metal. The existence of surface tension may be proved by drawing a needle between the fingers to give it a slight coating of grease and then carefully laying it upon some water in a bowl; although the needle will float upon the water, the surface will be depressed by the weight of the needle at that point. It is the surface tension that makes the drops of liquids, including melted metals, round, because its power must be equal in all directions.

The surface tension of the melted metal tends to make the metal hang above the bottom of the V, if the weld is not made entirely through the bottom of the V, which will result in imperfect work. If the bottom of the V is burnt through the V will be too narrow and the metal will tend to form a bridge, as the bottom edges of the vertical sides cannot be reached by the torch to melt them together. It is then necessary to burn down the sides and through the bottom of the V, thus leaving a wide opening which must be filled at a large expenditure of labor and gases. On the other hand, if a wide V is made, the bottom edges can be fused together and even allowed to fall a little below the bottom surface. The surface tension this time is an advantage, as it prevents the metal from going too far if properly handled. Then still more metal should be melted down from the sides of the V, so that the top will become wider and the bottom will have the shape of a shallow cup. The welding can then be proceeded with in the usual way. It is not to be assumed of course, that a wide weld is necessarily a good one; but a narrow one is invariably bad. * * *

Now-carbon Steel Cannot Be Burnt with a Neutral Flame

Burning of steel may mean one of two things. When the term is used by blacksmiths and metallurgists, it means that the steel has been overheated and has become brittle or, rather, crumbly when hot, and brittle when cold, due to a mechanical separation of the grains. This has been stated by Professor Howe as follows: "But if the overheating is extreme, then the cohesion between the adjacent grains becomes so feeble that they are forced apart to a certain extent by gas evolved from within. This gas probably consists, at least in part, of carbonic oxide, formed by the union of the infiltering atmospheric oxygen with the carbon of steel; such steel is said to be 'burnt' as distinguished from that which is simply overheated: and we may provisionally adopt this distinction, that burning consists in a mechanical separation of the grains on extreme overheating. Burnt steel is recognized by its extreme brittleness, both hot and cold, its coarse, shining fracture, and the oxide coating which we often find in that fracture."

Burnt steel can usually be readily identified, as a low magnification shows that it contains cracks. The burning does not take place where the steel is melted, but occurs next to the fused part; that is, close to the welding line in a weld made in high-carbon steel. It is for this reason that high-carbon steel cannot be welded. While the weld may be all right, damage to the original material next to the weld cannot be avoided, as there must be a zone where the heat conditions are just right to cause burning. For this reason a welded piece of such steel always breaks close to the weld. The other kind of burning is that which occurs in using a cutting torch. In this case, the steel is almost entirely converted into oxide, which is, of course, a genuine burning, similar to the burning of coal or wood.

The writer has never been able to detect the first kind of burning in low-carbon steel, either in the weld or in the original material, even when the weld is made with a strongly excess oxygen flame. Such a flame will make the welded metal boil and produce a large amount of slag in the form of a white foam, which will float to the surface if a large pool of melted metal is maintained. Of course, this is bad practice, not only because of the wasted metal, but because such a weld contains much more oxide, in the form of small dots, than a weld made with a neutral flame. * * *

A Ripple Weld Is Not Always a Good Weld

When done by an expert, a true ripple weld is a work of art. The ripples are uniform both in size and spacing and create the pleasing impression of a good job. These welds are usually seen at their best in thin steel, say sheets not over ⅛ inch thick, but in heavier sheets the writer has never seen a ripple weld that has gone entirely through. In material up to ⅛ inch thick, the necessary penetration can be obtained; but in sheets ⅛ or ¼ inch thick, it is impossible to obtain a sound weld with a full ripple effect where metal has to be added. In light sheet welding, strength is usually a secondary matter and an imperfect weld may be good enough. In barrel welding machines it is necessary to weld from both the inside and the outside, the inside torch following the outside one and making a sound weld. The material used in this case is about ¼ inch thick and no metal is added.

A Narrow Weld Is Not a Good Weld

The writer does not believe it possible to make a narrow weld entirely through the sheet, and he has seen so many poor narrow welds, with never a good one, that he would condemn a narrow weld by outside inspection alone. By a narrow weld is meant one in which the width of the top of the weld is less than two and a half times the thickness of the sheet; and even this is less than is really safe, in the writer's opinion, and he prefers a ratio of three to one. When it is considered that with a 90-degree angle of the V the opening at the top is twice the plate thickness and that the plates should be a trifle apart, say ⅛ inch for plates ½ inch and more in thickness, it will readily appear that with a ½-inch sheet, the width of the top of the V, with a space of ⅛ inch at the bottom, will be 1⅛ inch, which leaves only ⅜ inch on each side for melting down of the original, if the ratio of 2½ to 1 is selected, which is little enough.

Questions Involving Possibility of Danger to Life or Property Should Not Be Decided by Subordinates

One of the real troubles in the welding industry is to find foremen who appreciate the problems involved, that is, men who can be made to feel that welding is more than a mechanical job. All kinds of men have been selected for this position and for all kinds of reasons. One superintendent may prefer a blacksmith because the blacksmith is familiar with steel and wrought iron, but he ignores the fact that the blacksmith knows nothing about cast iron, brass, aluminum, etc. The same line of reasoning may be applied in the case of any mechanic. Each trade finds its special knowledge useful in welding, and a first-class welder should know something about all metal trades. A welder who does only one thing may be trained quite easily in a short time, and he need not have much knowledge except how to do his special work correctly, but the man in charge of the work must know more than this. A person ignorant of the elementary practices of metallurgy and mechanics cannot be safely entrusted with welding work that involves possible damage to person and property, but a man who is otherwise competent and willing can be taught the necessary technical details. When those in authority fully realize their responsibility in this matter, proper methods of instruction, such as welding schools and trade journals, will come into their own, and expert metallurgists and engineers will not consider it beneath their dignity to be called into consultation when important welding work is being contemplated, planned, or actually executed.

It is also necessary for the expert metallurgist or engineer to realize the practical difficulties in welding. There is no mechanical process that appears so easy, and is in reality so difficult, as the successful handling of a torch. [A great deal of loose talk is indulged in by salesmen of welding

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apparatus and other interested persons as to the ease of learning the work, and the uninitiated superintendent later wonders why his welders do not produce the desired results. A welder who has had considerable experience in training others said that superintendents and master mechanics frequently complain of the length of time required to train men for such easy work. His answer is to induce them to try the work, with the result that invariably, after a minute or so, they find some reason for going to another department; but they do not again complain of the lack of speed.

These facts have been stated not to make it appear that it is almost impossible to learn the art of welding, but to show that the principles of the art must be taught by metallurgists and engineers. The amount that should be taught any individual depends on conditions; but the principles must be developed in the laboratory and the work must be controlled by it in just the same way as the heat-treatment of alloy steels was developed and is handled. (Machinery.)

Exhibit of Air Reduction Sales Co., at Meeting of Traveling Engineers' Association.

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The cutting of cast iron with an oxy-acetylene or other high-temperature cutting torch is generally considered impossible because the melting temperature of the oxide which forms on the cast iron is higher than that of the metal itself. Wrought iron or steel has a higher melting temperature than the oxide of iron which forms when the oxygen jet of the cutting torch is applied; consequently the oxide melts and either flows or is blown away from the surface against which the flame is directed. As the result of this constant removal of the oxide in the case of wrought iron and steel, new surfaces are continually exposed to the action of the oxygen jet, so that the metal is literally burned as the cutting proceeds. The difficulty in cutting cast iron is due to the fact that the metal melts sooner than the oxide and the latter interferes with a burning or ox[illegible]ing action.

Notwithstanding this theory, an oxy-acetylene torch was [illegible]ed very effectively at the Graves Machinery Exchange, 305 John-son Ave., Jersey City, N. J., for cutting away sections of the ribs of a large cast-iron boring mill table in connection with its repair. This table, which is shown in the accompanying illustrations, Figs. 1 and 2, (a cast iron table, about 12 ft., not shown here) was badly cracked through the hub, and as it is part of a fourteen-foot boring mill and weighs about twelve tons, it would have been very expensive to replace. In order to strengthen the hub, it was decided to shrink around one end a 4- by 4-inch steel ring, which involved cutting away sections of the 2¼-inch ribs in order to form a place for the steel ring.

Fig. 1 shows a view of the boring mill table, and this illustrates how the ribs have been cut away next to the hub. Fig. 2 shows how an oxy-acetylene torch was used for this purpose. This torch has six small holes in the tip for the pre-heating jets which surround a larger central hole for the oxygen. Attempts were made to cut the casting with a tip having only four outer holes, but this form of tip could not be used. The torch is adjusted to give a rather long preheating flame. The pressure of the acetylene is about 30 pounds per square inch, and of the oxygen, 90 pounds per square inch. This method of removing the rib sections saved considerable time, as a 4- by [illegible]-inch piece was cut out of each rib in ten or twelve minutes by means of the torch. The edges of the cut-out sections were left soft and could easily be trimmed by chipping. While the composition of this casting is not known, it probably contains considerable scrap.

It is claimed, however, that other cast iron of the gray iron variety has been cut successfully. F. D. J.

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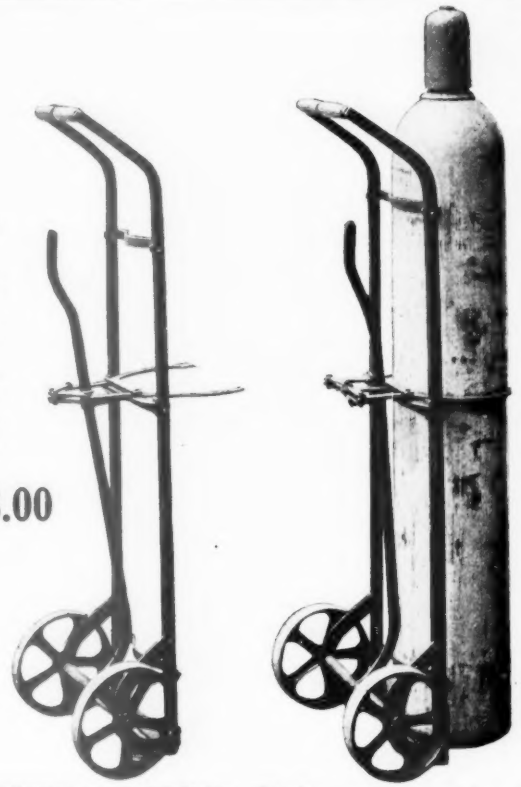

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The electric welding committee of the Emergency Fleet Corporation held a joint session with the Philadelphia sections of the Association of Iron and Steel Electrical Engineers and the American Institute of Electrical Engineers and the Engineers' Club of Philadelphia, at the Bellevue-Stratford Hotel, Philadelphia, September 16, at 8 p. m. The subject of "Electric Welding, a New Industry," was discussed.

The Chicago Eye Shield Co. are introducing a new blue glass made for welders. This glass eliminates the white filament and has been very scarce on account of the war. It is known as "CESCO" blue. Particulars will be furnished upon request.

The Toronto (Canada) office of the Metal & Thermit Corporation has been moved to 15 Emily Street.

The Atlas Foundry Co., Irvington, N. J., who specialize in the manufacture of high silicon cast iron welding rods in all sizes, report a fast growing business. Mr. William H. Mantz, general manager of this company, was formerly connected with a large foundry specializing in welding rods, and he has made a study of the requisites in a cast iron welding rod. The company specializes in special shapes and sizes of rods.

The Chicago office of the Commercial Acetylene Supply Co. has been moved to Room 855, No. 208 S. La Salle St.

Major Roy A. Shaw, formerly of the Union Carbide Sales Co., and recently mentioned in these columns, is now in France, actively identified with our army welding problems.

During a patriotic parade in New York on July 4th, one float exhibited an oxy-acetylene welding outfit, loaned by the Brooklyn Navy Yard.

Several manufacturers of welding equipment will exhibit at Milwaukee during the Foundrymens convention, Oct. 7-11. Among them are Davis-Bournonville, Torchweld Co., Imperial Brass Co., and the Oxweld Co.

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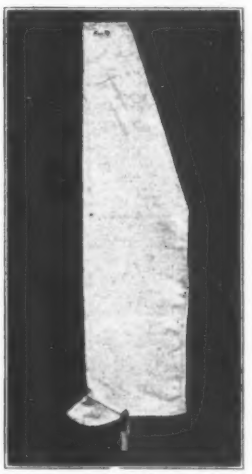

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Ten years ago the oxy-acetylene method of welding and cutting metals was hardly more than a laboratory process, but in the course of these few years it has become one of the most important of the methods in the metal-working industries. Much has been published relating to this process, but a great deal of that which has been placed on record in the past has been descriptive of odd jobs. It is, therefore, believed that the present volume, dealing in a more systematic manner with the principles and practice of the art of oxy-acetylene welding, will be of considerable value to those engaged in the metal trades.

The information here presented on the subjects of oxy-acetylene welding and cutting has been mainly furnished by S. W. Miller, proprietor of the Rochester Welding Works, whose wide experience in the practical application of the process, and whose success in the work, vouch for the reliability of the information here placed on record. The experience of the author in the oxy-acetylene welding field has been unusually extensive, but having been mostly on repair work, he has written especially for those engaged in a similar line. A great deal of the work done with the oxy-acetylene welding torch is on repairs, and while there are also a great many applications of it in manufacturing work, such applications are more or less special in each case, and sometimes require a great deal of experimenting before success is attained. The general principles here presented, however, apply equally to repair and manufacturing work. This volume describes the equipment required for oxy-acetylene welding and cutting, deals in detail with methods used in welding cast iron, malleable iron, steel, copper, brass, bronze, and aluminum and gives in addition, special attention to the welding of sheet metal, tank welding, boiler repairs, etc., as well as to the subject of lead burning, which is a special kind of autogenous welding.

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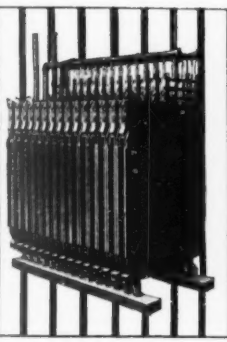

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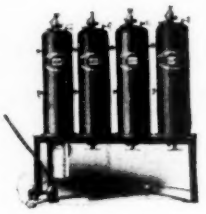

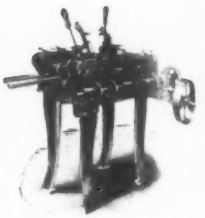

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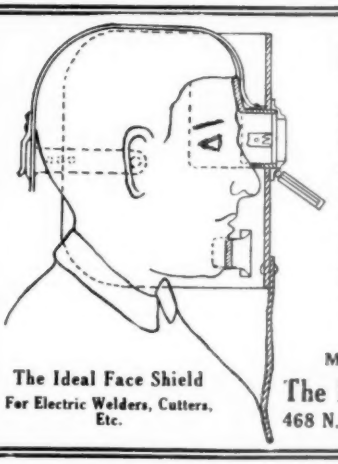

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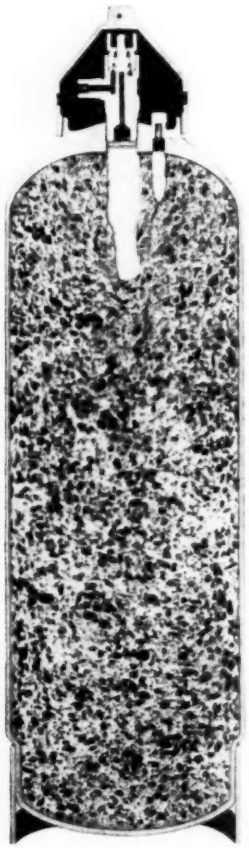

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